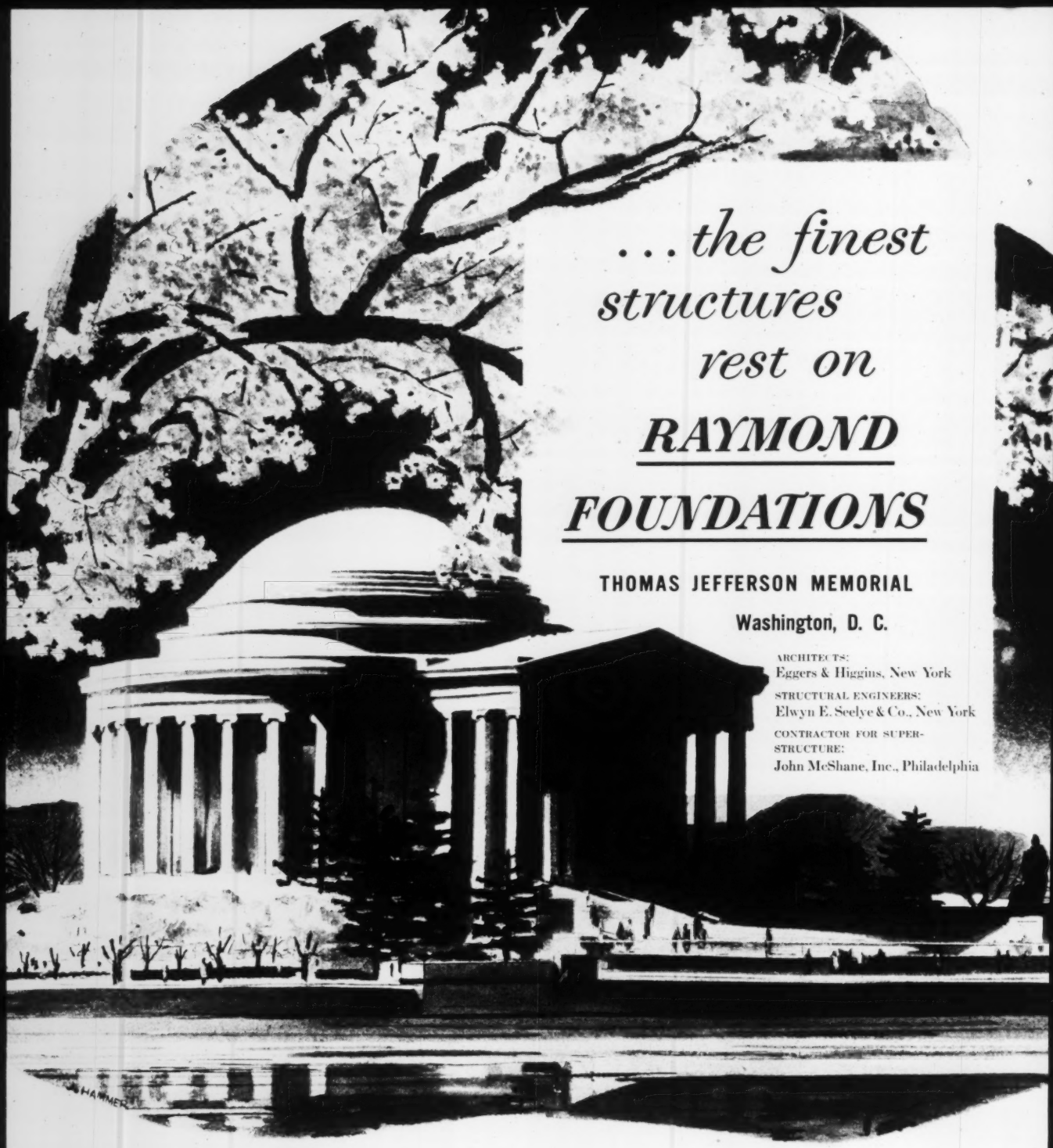
CIVIL ENGINEERING

NEW YORK STATE THRUWAY



. . . the finest structures rest on

RAYMOND FOUNDATIONS

THOMAS JEFFERSON MEMORIAL

Washington, D. C.

ARCHITECTS:
Eggers & Higgins, New York

STRUCTURAL ENGINEERS:
Elwyn E. Seelye & Co., New York

CONTRACTOR FOR SUPER-STRUCTURE:
John McShane, Inc., Philadelphia

RAYMOND'S DOMESTIC SERVICES . . .
Soil Investigations • Foundation Construction • Harbor and Waterfront Improvements Prestressed Concrete Construction • Cement-mortar Lining of Water, Oil and Gas Pipelines, In Place.

RAYMOND'S SERVICES ABROAD . . .
In addition to the above, all types of General Construction.

AROUND THE WORLD FOUNDED 1891

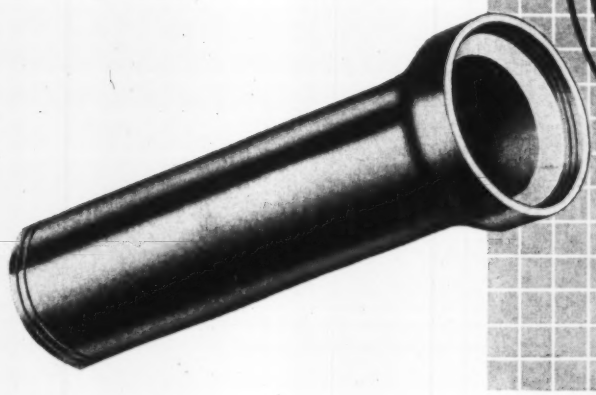
RAYMOND
CONCRETE PILE CO.
140 Cedar Street • New York 6, N. Y.

Branch Offices in Principal Cities of the United States, Central and South America

Tests Prove

CLAY PIPE

holds its shape



wet or dry!

Clay Pipe can't "oval" or squash out. Its easy-to-handle lengths *hold* their shape—wet or dry . . . hot or cold . . . under live or dead loads. Comparative laboratory tests prove there's no safe substitute for Clay Pipe. It doesn't expand or contract, never turns spongy in contact with detergents and other chemicals, can't squash out under backfill loads. Clay Pipe is proof against chemical action.

That's why it always pays to use Clay Pipe. *Every section is guaranteed for 50 years.* And Clay Pipe contains no critical, urgently needed raw material. It's *all* clay—readily available. It never wears out!

NATIONAL CLAY PIPE MANUFACTURERS, INC.
1520 18th St. N. W., Washington 6, D. C.
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ESSENTIAL • ECONOMICAL • EVERLASTING

C-953-1

Vitrified
CLAY
CLAY PIPE NEVER WEARS OUT!
PIPE

CIVIL ENGINEERING, The Magazine of Engineered Construction, November, 1953. Vol. 23, No. 11. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50¢ a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75¢ and foreign postage $1.50 additional. Entered as second class matter September 23, 1930, at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

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PRESSURE SPHERES

FOR THE STORAGE OF *Ammonia*

- EFFICIENTLY
- DEPENDABLY
- ECONOMICALLY

PITTSBURGH•DES MOINES

Steel Pressure Spheres for the storage of ammonia are typical of the wide range of vessels fabricated by Pittsburgh-Des Moines for containing liquids and gases of many different kinds. The sphere illustrated is 65 ft in diameter, and operates at 55 lb working pressure.

● Let us consult on your storage problems of pressure and temperature, and quote on the correct structure for your particular needs.

PITTSBURGH•DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

Sales Offices at:

PITTSBURGH (25) . . . . . 3470 Neville Island
NEWARK (2) . . . 251 Industrial Office Bldg.
CHICAGO (3), 1274 First National Bank Bldg.
LOS ANGELES (48), ... 6399 Wilshire Blvd.
DES MOINES (8), 971 Tuttle Street
DALLAS (1), 1275 Praetorian Bldg.
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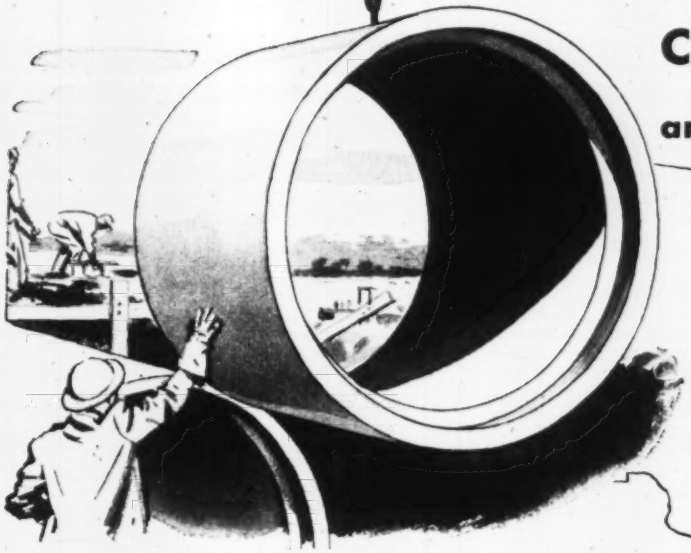
SANTA CLARA, CAL., 677 Alviso Road

AMERICAN A-M MARIETTA

. . . now the Nation's Largest Producer of CONCRETE SEWER and DRAINAGE PIPE



American-Marietta's expansion fulfills a national need by making exclusive products of these fine companies available to all America

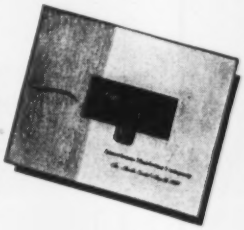
LAMAR PIPE & TILE COMPANY—revolutionizing municipal sewer construction with the exclusive oval-shaped "Tunneliner" pipe, which passes through itself to extend a tunnel without surface excavation.

CONCRETE PRODUCTS COMPANY OF AMERICA—famous for drainage pipe and pre-stressed concrete bridge sections with designs licensed to numerous other firms.

UNIVERSAL CONCRETE PIPE COMPANY—leading manufacturer of concrete pipe for sewers and drains. Pioneers of flat-base pipe and package bridges for highway construction.

In the precast concrete field, our recent expansion has again increased our growth potential. Designers and builders like the advantages of our many products and the way we pace our activities with advance research. There will be important benefits for both customers and shareowners as we better serve a growing America.

American-Marietta's dynamic growth record is a story of planned expansion in diversified, basic industries. A copy of our 1953 Semi-annual Report of Progress will be sent upon request. Address: Dept. CP.



A-M

AMERICAN-MARIETTA COMPANY

General Offices: American-Marietta Building, 101 East Ontario Street, Chicago 11, Illinois

Plants Located Throughout the United States and Canada

PAINTS • CHEMICALS • ADHESIVES • RESINS
METAL POWDERS • BUILDING MATERIALS • HOUSEHOLD PRODUCTS

NEW!

EIMCO 105's are new equipment for mining, construction, quarry, tunneling, logging, oil fields, farming or any job requiring a thoroughly tough unit as a prime mover, bulldozer, or loader.

Machines are designed, usually, for a weight limit to sell at a price OR THEY ARE DESIGNED FOR SERVICE. EIMCO machines have always been designed for service — weight and price receive no consideration. The result in this case is a unit designed to give maximum life — (3 to 4 times more than ordinary equipment in the same class) — with minimum maintenance attention. Trouble free service for many years on the job.

Construction is rugged, with each piece designed for maximum loading conditions — using the most modern metallurgical research and best in tooling and equipment. Each part is processed to give it toughness and hardness in the right places.

On the EIMCO 105 you'll find no weak spots designed to produce repair parts sales. No bulk weight spots to provide "cheap beef". Every part is functional — made of steel — fabricated, or alloy steel forgings and castings. The 105 is powered to give maximum effective use of every ounce of energy applied.

See this unit in action — operate it yourself. There is nothing like it anywhere! You'll be amazed at the easy controls, the performance — the simplicity. Write for more details.

The Eimco Corporation, manufacturers of heavy mining, construction and processing equipment and has been serving industry since 1884. With its own complete manufacturing facilities, which include iron and steel foundries, steel fabrication shops, forge and press shops, complete machine and assembly shops, laboratories, research, testing and process development departments, Eimco controls the manufacture of the product from [illegible] of the metal to casting of the finished product.

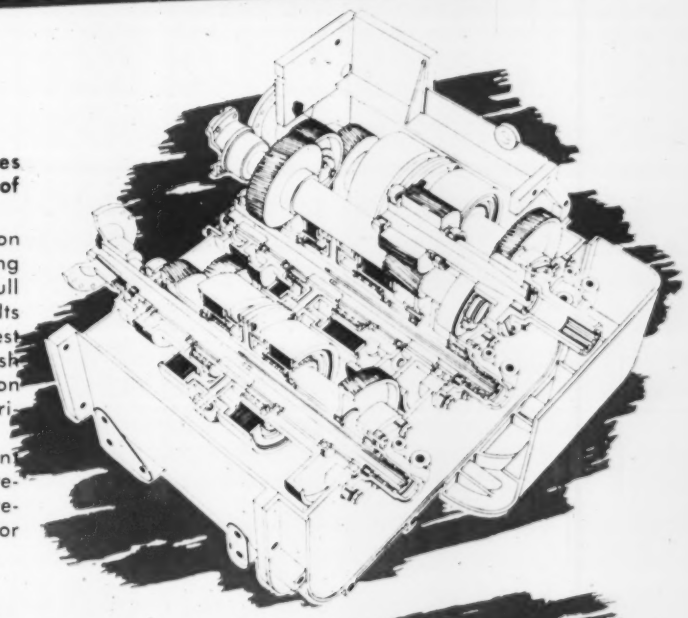
LOADER—WITH COST SAVING ADVANTAGES

NEW Transmission:

Eimco's great new Unidrive achieves supremacy in engineering advancement of tractor power transmissions.

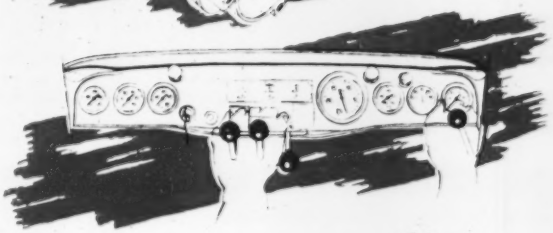
The Unidrive is a compact transmission containing in one unit all of the gearing and clutches for speed changing and full independent reversal of each tracks. Its unique design combines all of the best features of torque converter, constant mesh gearing, hydraulically actuated friction clutches and sealed oil bath, pressure lubrication of all wearing parts.

The oil-cooled, positive engagement clutches never need adjustment. The precision helical gearing is alloy steel, carefully heat-treated and micro-shaved for years of quiet operation.



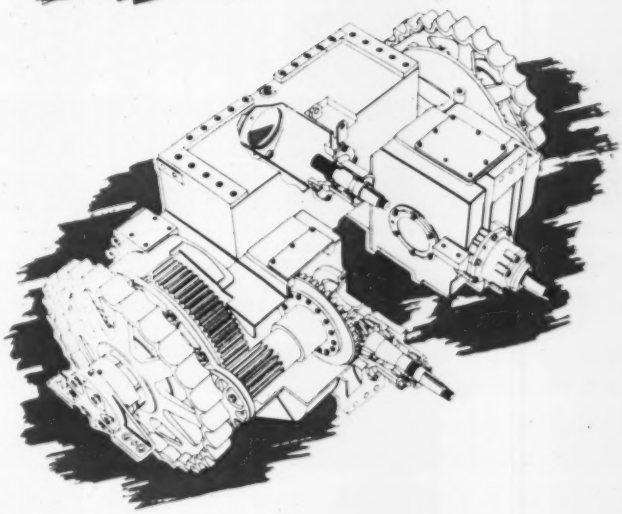
NEW Controls and Instruments:

The Eimco 105 may be operated by one hand covering two small levers. Push for forward motion, pull for reverse motion. Each lever controls the track on its respective side, a twist of the wrist starts one track in forward motion and the other in reverse for a spin turn or release one handle and it will automatically return to neutral for a gradual turn. Attachments, such as the Eimco loader can be operated by the other hand.



NEW Final Drive:

Each track is equipped with its own final drive in a cast steel case with a cast steel cover. These final drives do not house clutches or troublesome gadgets. They are sturdy heavy-duty parts carefully machined for silent operation and long service under unusually difficult job conditions.



NEW Other Features:

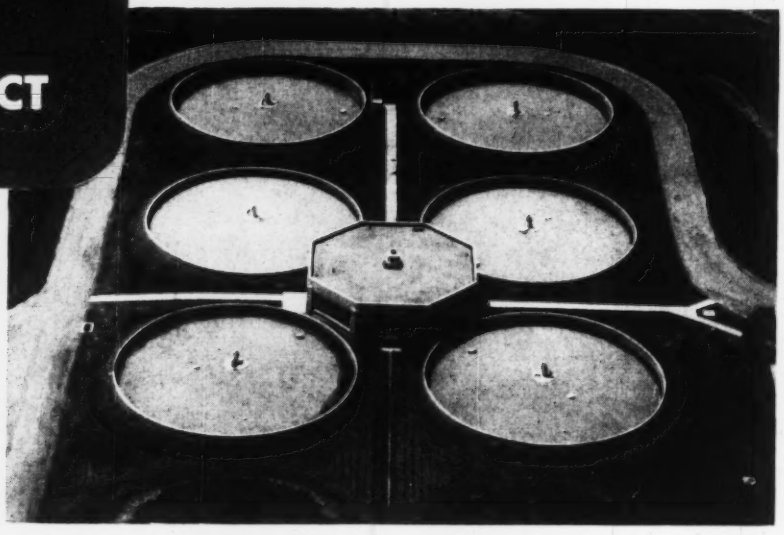
There are many other features in the 105 such as: instant reverse at all speeds, torque converter cushioned drive, air cooled precision disc brakes, all metallic clutch facings, full flow oil filters, force feed lubrication, adjustable digging depth stops, variable height discharge, 1½ to 2½ cubic yard buckets and many others.

EIMCO

THE EIMCO CORPORATION
Salt Lake City, Utah, U.S.A.
Export Office: Eimco Bldg., 52 South St., New York City

ACCELERATED SLUDGE DIGESTION NOW A FACT

*Exclusively through the Catalytic Reduction Process**



CRP

CATALYTIC REDUCTION PROCESS

The Catalytic Reduction Process completes biological sludge digestion in one-third to one-fourth of digester volume generally required. The Process accomplishes this by digesting at solids loading rates three to four times those being practiced. This accelerated digestion is simple and economical, using only the natural products of anaerobic decomposition.

Originating in 1946, the Process was developed, tested and verified over six years on both laboratory and pilot plant scale. The results obtained in the pilot plant operation have been proven in full scale plant operation at the Columbus, Ohio Sewage Treatment Works in 1952 and 1953.

The Catalytic Reduction Process applied to one 70′ tank at the Columbus Plant digested 3.38 times the quantity of sludge solids digested in a similar tank in parallel operation not using the Process. The tank operated under the Process produced a reduction of solids within established ranges, normal gas production and readily driable odorless sludge.

The Catalytic Reduction Process is now available for consideration by consulting engineers for application on plants under design and for plants requiring expansion. The Process when applied to overloaded digesters will provide sufficient capacity without additional tanks.

**The only proven Process for accelerating biological digestion. (Patents applied for.)*

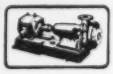
The Catalytic Reduction Process is offered through the Catalytic Reduction Co., Inc. a subsidiary of the Chicago Pump Company.

CHICAGO PUMP COMPANY

SEWAGE EQUIPMENT DIVISION

622 DIVERSEY PARKWAY — **CHICAGO 14, ILLINOIS**

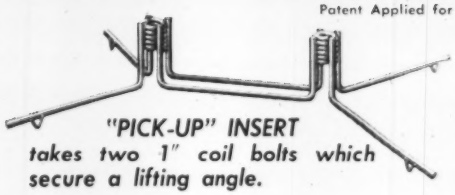
Flush Kleen, Scru-Peller, Plunger Horizontal and Vertical Non-Clogs Water Seal Pumping Units, Samplers



Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Comminutors.

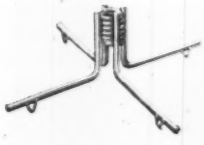
3 SUPERIOR ACCESSORIES FOR more efficient handling of "TILT-UP" SLABS

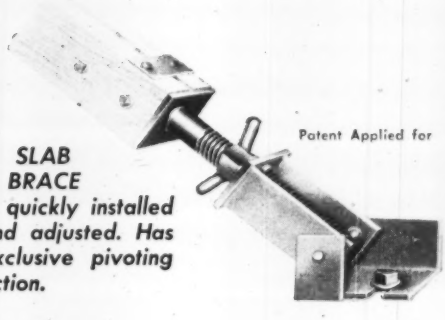
Patent Applied for



"PICK-UP" INSERT takes two 1" coil bolts which secure a lifting angle.

"ANCHOR" INSERT in both the "Tilt-Up" slab and the floor slab provides anchorage for slab brace bolts.





Patent Applied for

SLAB BRACE is quickly installed and adjusted. Has exclusive pivoting action.

Are you bidding on a "Tilt-Up Slab" job? Are you starting a "Tilt-Up Slab" Job? Then you will be interested in these SUPERIOR accessories, designed for faster and more efficient handling of precast panels.

The Superior *"Pick-Up" Insert* provides dependable anchorage for bolts which secure a lifting angle to which slings are attached when the panel is raised. *"Anchor" Inserts* in both the "Tilt-Up" slab and the floor slab secure the temporary bolts to which the braces are attached. With Superior's adjustable and pivoting *Brace* you have an efficient as well as inexpensive answer to both ordinary and unusual bracing problems . . . you merely assemble with 2 x 4's of lengths to fit individual jobs.

Wherever slabs are being "tilted-up" . . . on the Pacific Coast . . . in the Midwest . . . the South, and in the East . . . contractors are consistently using Superior Inserts, Anchors and Braces. For details request a copy of Bulletin TU-2.

SUPERIOR CONCRETE ACCESSORIES, INC.

4110 Wrightwood Avenue, Chicago 39, Illinois

New York Office
1775 Broadway, New York 19, N. Y.

Pacific Coast Plant
2100 Williams St., San Leandro, Calif.

TRAVERS DAM:

$20,000,000 job expected to return $25,000,000 a year

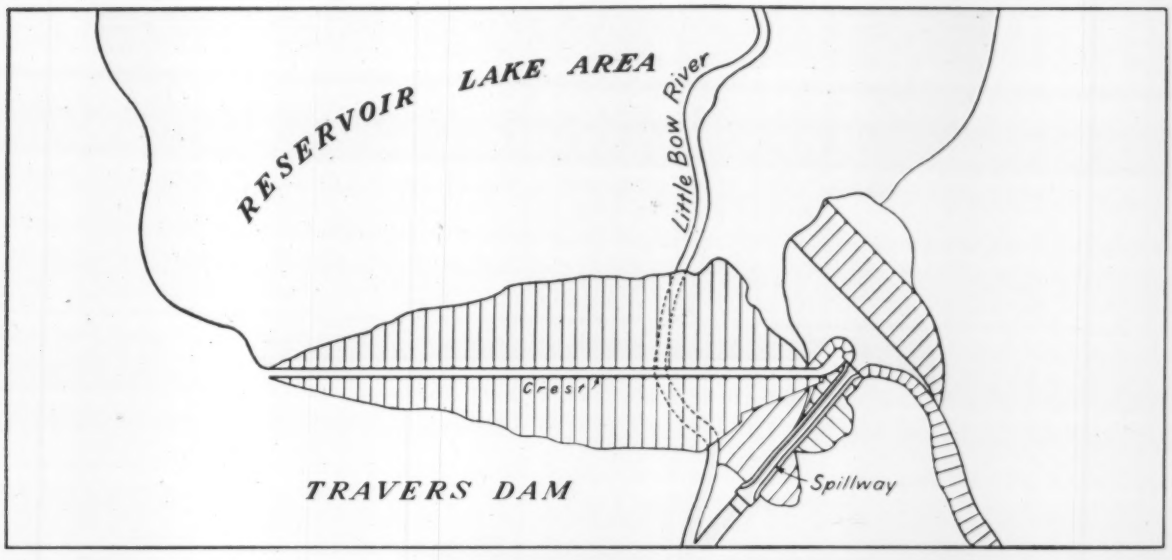
A Cat DW20 with No. 20 Scraper loads earth on the Travers Dam site. ▲

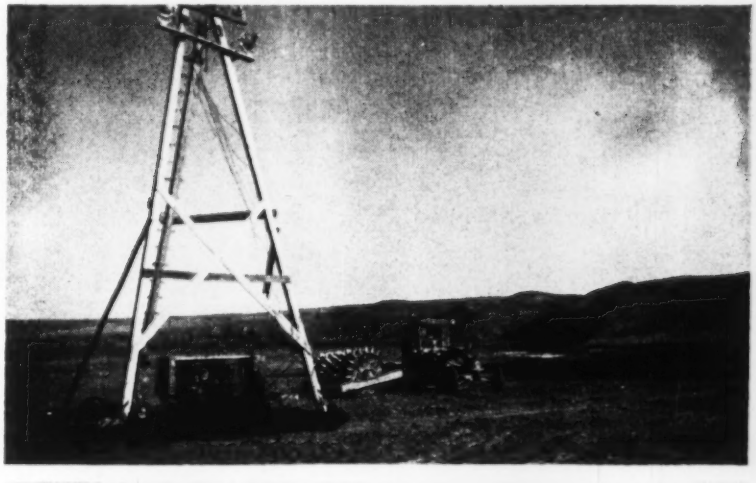
Haul roads are maintained by this No. 112 Motor Grader. The naked hills are typical of this arid region. ▼

A region of arid wasteland will be brought under irrigation by the Bow River Development, now taking shape in southern Alberta, Canada.

At an estimated over-all cost of $20,000,000, the project will ultimately bring water to 240,000 acres, with a potential yearly crop yield valued at $25,000,000—a 125% annual dividend on the investment!

Largest single structure in the development is a big earthfill dam across the valley of the Little Bow River,





This Caterpillar D311, mounted on skids, generates power for lighting the dam at night.

southwest of Travers, Alberta. When completed it will contain about 4,500,000 cubic yards of material. Rising 110 feet above the original river bed, the dam will be 3030 feet long at the crest and 940 feet thick at the base. It will impound a reservoir lake 15 miles long, containing 250,000 acre-feet of water, and forming a connecting link between Lake McGregor Reservoir and Little Bow Reservoir.

As on nearly all other big earthfill projects, Caterpillar* equipment is being used for a large part of the job. Emil Anderson Construction Co., Ltd., is moving earth from the borrow pit to the dam crest with Cat* DW20 Tractors and No. 20 Scrapers. The big yellow units average 21 cubic yards to the load and make 12 trips per hour on a 1200-foot haul. Part of the haul has been up a 20% grade, but each scraper has averaged 1000 yards a day with much less down time than equipment of other makes.

Caterpillar machines in the Anderson fleet also include D8 Tractors with No. 8A Bulldozers, Cat Motor Graders and a D311 Electric Set, used to floodlight the dam for night work. One of the reasons for the high production record set by this equipment is the prompt, reliable parts and repair service provided by the local Caterpillar Dealer.

A D8 Tractor with No. 8A Bulldozer handles big blade loads on the Travers Dam fill.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

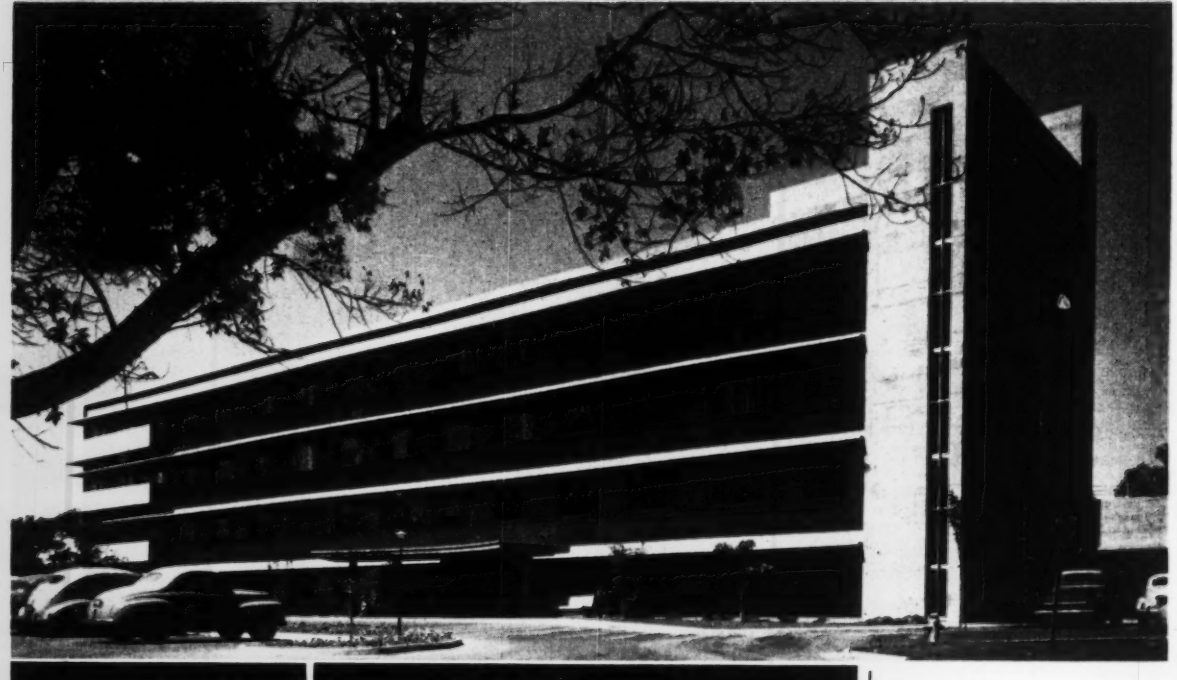
*Both Cat and Caterpillar are registered trademarks — ®

More and more, hospital designers are turning to reinforced concrete frames and floors, because reinforced concrete costs less. Construction time is important, too, and reinforced concrete buildings *go up faster.*

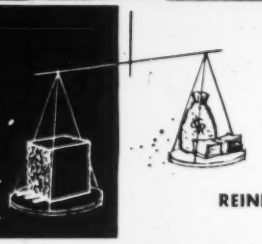
Reinforced concrete is inherently firesafe. It offers rugged strength that is highly resistant to wind, shock, and quakes. It permits great flexibilty of design. And materials are readily available from local sources.

These are reasons why reinforced concrete is so popular today. Whatever your next building may be—design it for reinforced concrete.

CUT YOUR STRUCTURAL COSTS
with REINFORCED CONCRETE



Marin General Hospital,
Greenbrae, Calif.
Architect:
Robert Stanton, A. I. A.
Structural Engineer:
MacD. Perkins



YOU'LL SAVE
WITH
REINFORCED CONCRETE

38 South Dearborn Street • Chicago 3, Illinois
CONCRETE REINFORCING STEEL INSTITUTE

PLASTIMENT*
CONCRETE Ddensifier

CONTROLS SET AND REDUCES WATER CONTENT WITHOUT INCREASING AIR CONTENT FOR

- **GREATER UNIFORMITY**
- **CRACK RESISTANCE**
- **WATER-TIGHTNESS**
- **SURFACE HARDNESS**

*Plastiment consistently produces higher structural values in concrete because it limits and controls the growth of water-consuming cement gels during mixing and placing of concrete. This action reduces the water-cement ratio and retards the set of all concretes, plain or air-entrained, regardless of type of cement or aggregate. Uniformity of set and water content (the governing factors of uniform concrete quality) are made possible by changing Plastiment proportions with concrete-placing-temperatures and field conditions.

Controlled set and uniformly low water content — exclusive with Plastiment — means less segregation, shrinkage, cold joints and other defects, greater uniformity and resistance to abrasion, cracking and leakage.

Write for your copy of "Plastiment, Concrete Densifier." For specific information on how Plastiment can benefit your own concrete projects, check with our engineering staff today.

SIKA CHEMICAL CORPORATION
PASSAIC, NEW JERSEY
BRANCH OFFICES: PITTSBURGH, SALT LAKE CITY, MONTREAL, PANAMA • DEALERS IN PRINCIPAL CITIES

Field installations and laboratory tests prove Plastiment's beneficial influence on uniformity, impermeability and resistance to cracking and abrasion.

Plastiment-concrete has been used in many of the world's outstanding projects — floating concrete drydocks, U. S. Navy — concrete ships and barges, U. S. Maritime Commission — Pier 57, New York — the world's largest prestressed concrete bridges and tanks — Metropolitan housing projects, Los Angeles and San Francisco — Gateway Center Buildings, Pittsburgh — and many others.

Lithographed on stone for U. S. Pipe and Foundry Co. by John A. Noble, A. N. A.

WINTER OR SUMMER, in the hills or on the flats, make no difference to cast iron pipe. Whether it is used for a water supply line, a gas feeder main or a pressure sewer, cast iron pipe has a rich history of highly satisfactory performance behind it for each type of service.

U. S. pipe centrifugally cast in metal molds up to 24-inch, pit cast pipe in the larger sizes and fittings are made in accordance with Federal, American Standard and American Water Works Association specifications wheresoever they apply.

With our production distributed in five strategically located plants, we are in an excellent position to meet your requirements.

United States Pipe and Foundry Co.,
General Office, 3300 First Ave., N. • Birmingham 2, Ala.
Plants and Sales Offices Throughout the U. S. A.

U.S.
cast iron
PIPE
FOR WATER, GAS, SEWERAGE AND INDUSTRIAL SERVICE

1935 · 1953

18 YEARS OF LOW COST WATER PURIFICATION

CHLOR-O-FEEDER FEATURES:

- Low first cost
- Low maintenance
- Interchangeable parts on all models
- Ease of installation and removal
- Packaged unit including all accessories
- Backed by a reliable manufacturing and service organization

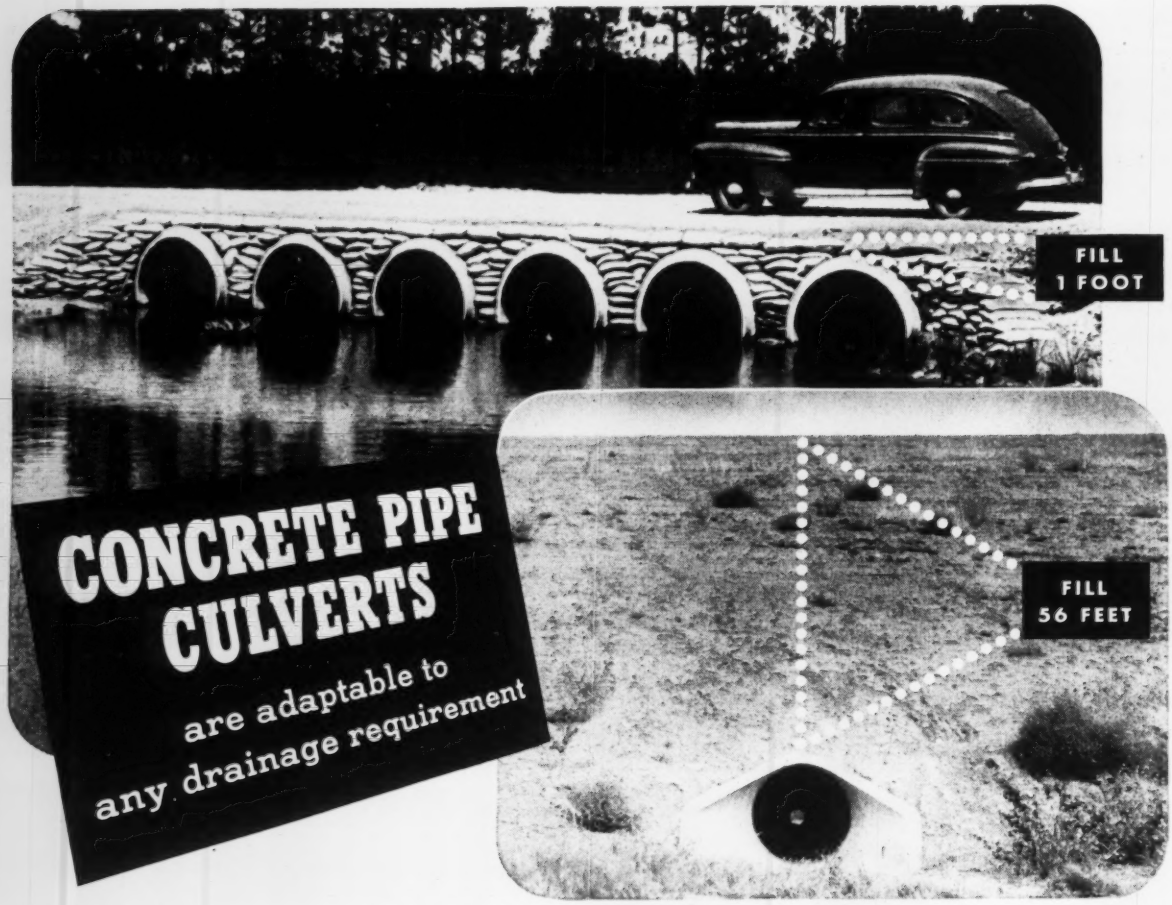
In 1935 this %Proportioneers% Heavy Duty Midget Chlor-O-Feeder was installed at the Canobie Lake Recreation Company, Salem Depot, New Hampshire. Here you see it about to be returned to active service after being completely overhauled at the factory. This unit was the *second* Heavy Duty Midget Chlor-O-Feeder to go into service anywhere in the world — now, because of interchangeability of parts, completely modernized ready for another 18 years of service.

Now let's review the actual expenses involved in this installation. Total cost, including installation, amortization and maintenance, for safeguarding the health of the patrons of the Canobie Lake Park has been less than $19.00 per year. This is a typical performance record for %Proportioneers% Heavy Duty Midget Chlor-O-Feeder.

Write for Bulletin 1201-1 describing %Proportioneers% Chlor-O-Feeder

%PROPORTIONEERS, INC.%

Consult your telephone directory or write to %PROPORTIONEERS, INC.%, 360 Harris Av., Prov. 1, R. I.
Technical service representatives in principal cities of the United States, Canada, Mexico and other foreign countries.



CONCRETE PIPE CULVERTS

are adaptable to any drainage requirement

Upper photo shows multiple-line concrete pipe culvert in Jackson County, Miss. built by Mississippi State Highway Department. Lower photo shows 72-in. reinforced concrete pipe under 56-ft. fill on U.S. Highway 10 near Mandan, N.D. The culvert is 252 ft. long. Built by the State of North Dakota.

WHETHER a culvert will have practically no overburden as in the multiple-line highway installation illustrated above or will have to bear an extremely high fill, it pays to select concrete pipe for the job. Adaptability to deep or shallow fills is only one of the qualities that makes concrete pipe the ideal choice for culverts anywhere.

Concrete pipe has demonstrated over and over again its versatility in solving all kinds of drainage problems. Whatever the site or drainage conditions, concrete pipe can be designed and installed economically to fill the need. Concrete pipe culverts are a good investment for many reasons:

1 **AMPLE STRENGTH** to resist the severe impact of heavy traffic, to sustain the heavy loads of high overburdens and to withstand the continued wearing action of severe climatic or soil conditions.

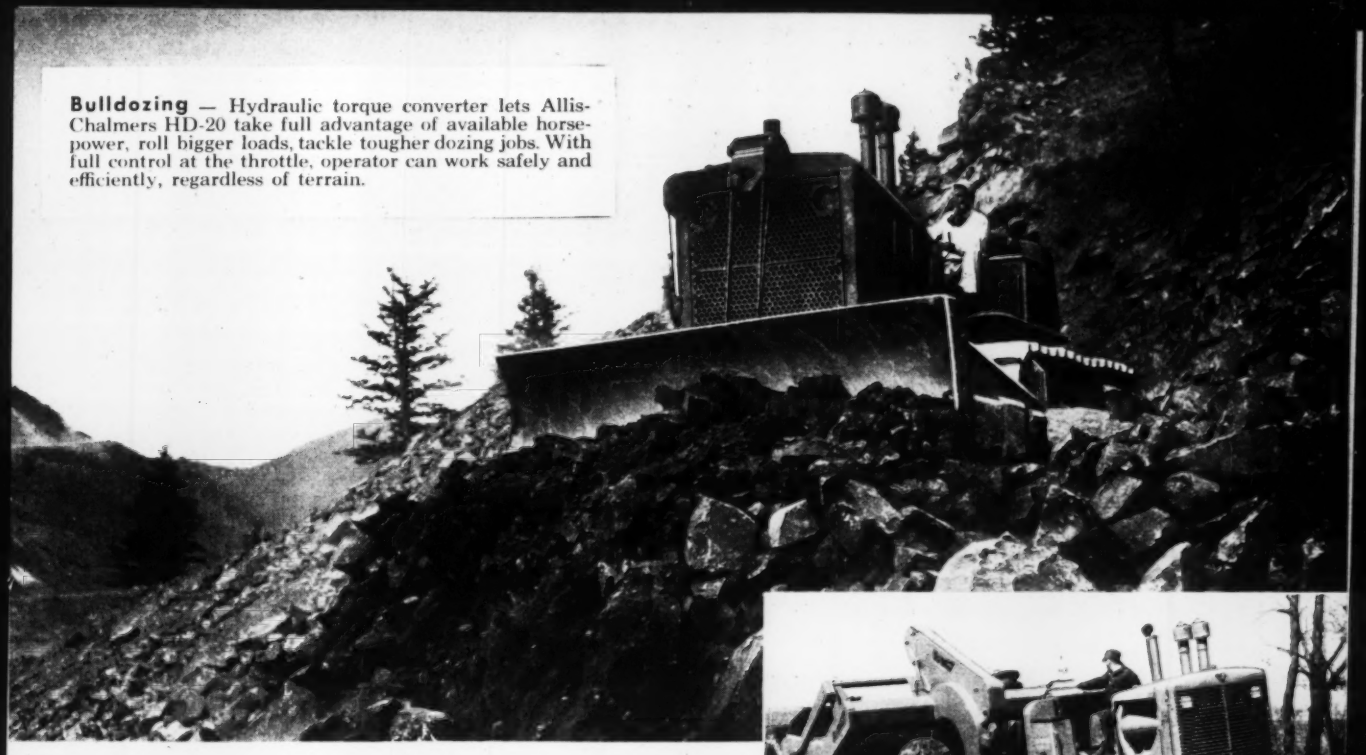
2 **MAXIMUM HYDRAULIC CAPACITY** due to smooth interior walls and clean, even joints.

3 **EASE OF INSTALLATION** makes concrete pipe ideal for new work, for replacing worn out culverts and small bridges and for jacking under highways or railroads without disturbing traffic.

4 **LOW-ANNUAL-COST ECONOMY** of concrete pipe culverts is the result of (1) moderate first cost, (2) extra long life as demonstrated by years of dependable service in thousands of installations under county, state and Federal highways and under most of the leading railroads in the country and (3) little or no maintenance expense.

AMERICAN CONCRETE PIPE ASSOCIATION

228 NORTH LA SALLE STREET, CHICAGO 1, ILLINOIS



Bulldozing — Hydraulic torque converter lets Allis-Chalmers HD-20 take full advantage of available horsepower, roll bigger loads, tackle tougher dozing jobs. With full control at the throttle, operator can work safely and efficiently, regardless of terrain.

AN ALLIS-CHALMERS REPORT

How hydraulic torque converter drive improves big tractor performance— increases job output

With a two-range transmission and hydraulic torque converter, the Allis-Chalmers HD-20 is the only crawler tractor that is capable of exerting maximum drawbar pull *at all times* . . . under all load and terrain conditions . . . without gear-shift guesswork.

Whatever the job, the operator need merely make contact with the load and then open the throttle. As the load requirements change, the hydraulic torque converter *automatically* matches the conditions with exactly the right combination of speed and pull.

This eliminates most shifting . . . leads to far more work done in a continuous work cycle . . . far longer equipment life.

• • •

Hydraulic torque converter drive, exclusive as standard equipment with Allis-Chalmers, is just one of many reasons why the HD-20 assures you higher output with less upkeep. Your nearby Allis-Chalmers dealer invites you to get the full story . . . and to see it in action.

WEIGHT — 41,000 LB. • 175 NET HP. AT FLYWHEEL

ALLIS-CHALMERS
TRACTOR DIVISION — MILWAUKEE 1, U. S. A.

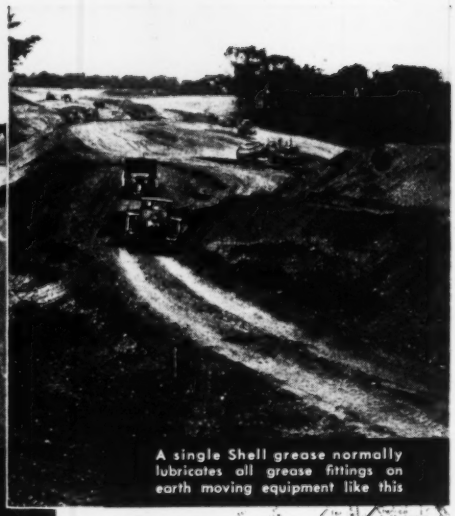
Pulling — Hydraulic torque converter drive actually multiplies torque up to four and one-half times . . . develops tremendous drawbar pull to start the load smoothly . . . and automatically accelerates to the highest speed that conditions permit, in either high or low range.

Pushing — Operator just makes contact, then opens the throttle and relaxes. The HD-20 automatically matches speed to that of pushed equipment, maintains steady contact while loading, sends load off to the fill at higher speed.

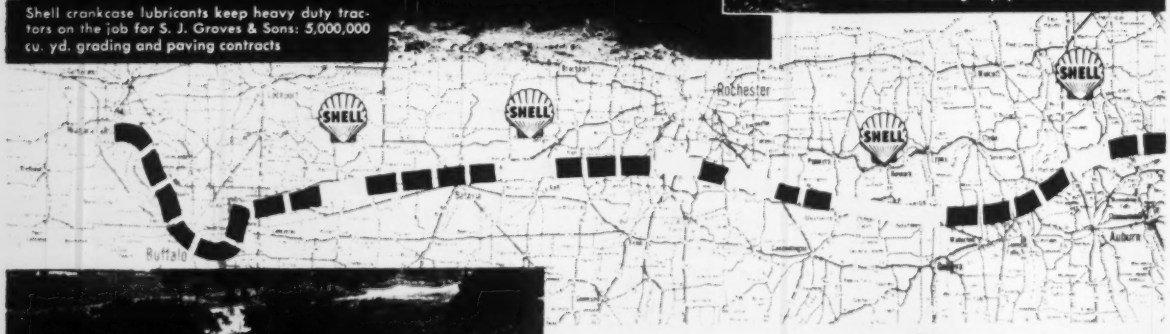
Digging and Loading — With the HD-20G, the operator crowds surely and steadily, using only throttle and bucket levers. With full horsepower always available even at creeping speed, he can work effectively in mud, on hillsides or edges of banks.

On the New York State Thruway

Shell crankcase lubricants keep heavy duty tractors on the job for S. J. Groves & Sons: 5,000,000 cu. yd. grading and paving contracts



A single Shell grease normally lubricates all grease fittings on earth moving equipment like this



Severe operation causes no motor problem with Shell Heavy Duty oil in the crankcase

Shell E. P. Gear Lubricant takes the punishment during rough going on steep grades

Arute Bros., Inc. depend upon the "stay-put" qualities of Shell's Multi-Purpose Grease for continuous heavy duty work

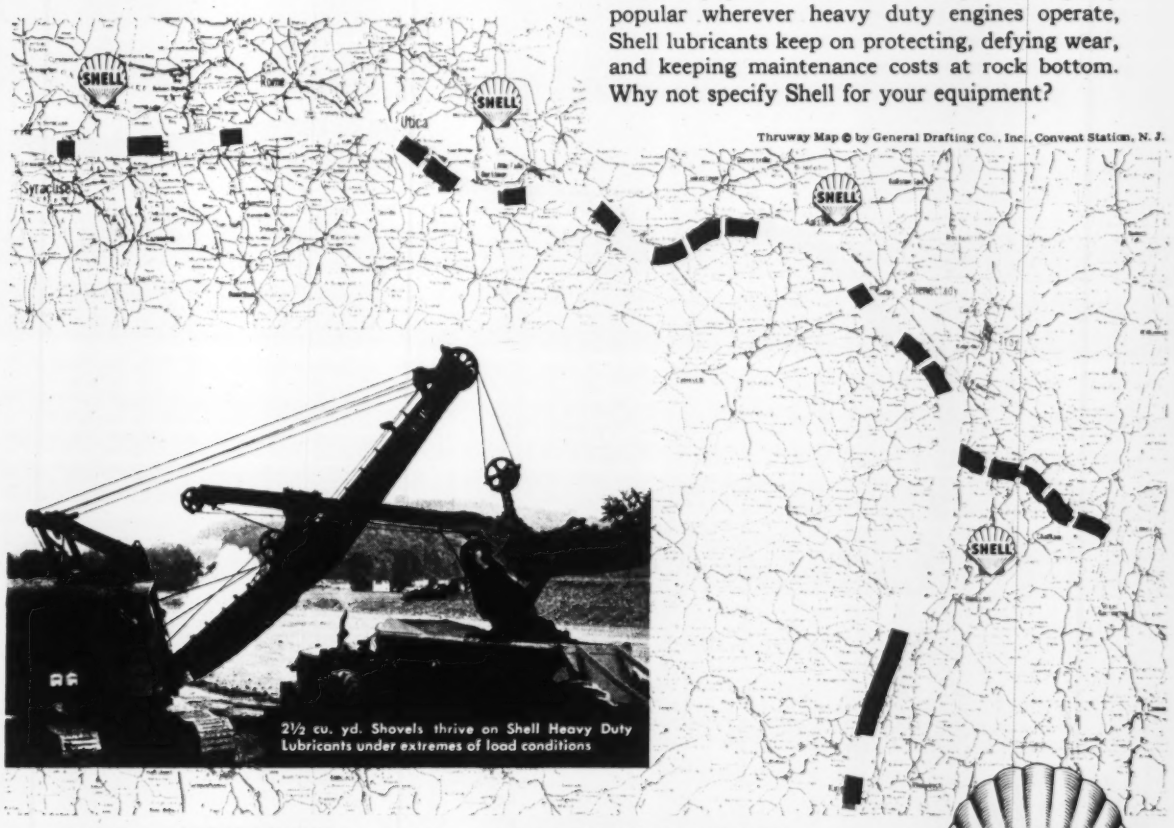
. . . 1 out of every 3 construction miles uses SHELL PRODUCTS *exclusively*

That's just one way of saying that Shell has been awarded contracts by companies responsible for building sections of the New York State Thruway totaling over one third of the entire mileage. And the contracts are still coming in!

Trucks, shovels, dozers, graders . . . all equipment run by gasoline or diesel engines on those long stretches of highway construction . . . benefit from the outstanding performance of Shell heavy duty lubricants.

Products that can win the unqualified preference of such responsible and efficient operators must have what it takes . . . and Shell products *have* it . . . plenty!

Most popular on the Thruway, and equally popular wherever heavy duty engines operate, Shell lubricants keep on protecting, defying wear, and keeping maintenance costs at rock bottom. Why not specify Shell for your equipment?



Thruway Map © by General Drafting Co., Inc., Convent Station, N. J.

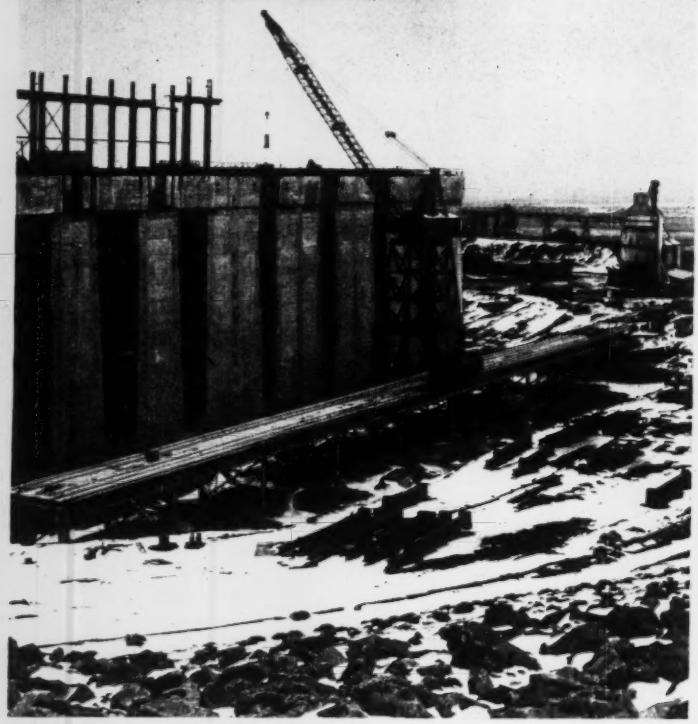
2½ cu. yd. Shovels thrive on Shell Heavy Duty Lubricants under extremes of load conditions

SHELL OIL COMPANY

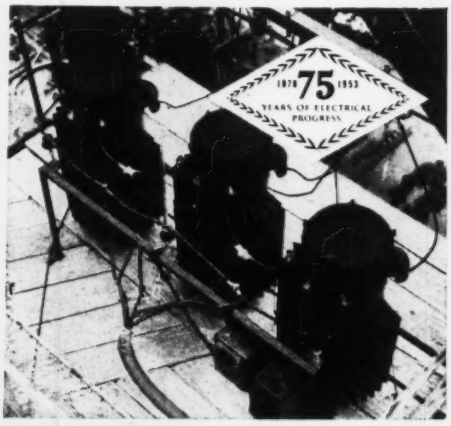
50 WEST 50TH STREET, NEW YORK 20, N. Y.
100 BUSH STREET, SAN FRANCISCO 6, CALIF.

SHELL

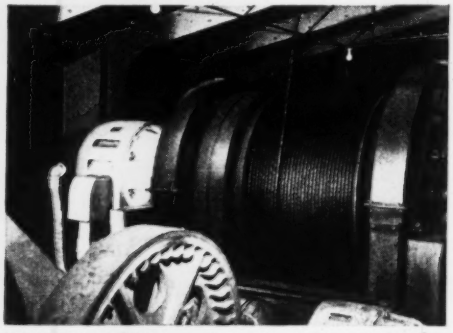
ENGINEERING REPORTS:



ELECTRICAL CO-ORDINATION provides continuous operation of this revolver crane 100 feet above the base of the huge intake structure. Movement along trestle is powered by a G-E 200-hp Type MR motor at foot of the gantry.



ADEQUATE POWER to maintain smooth, dependable crane performance is stepped down by these portable G-E transformers.



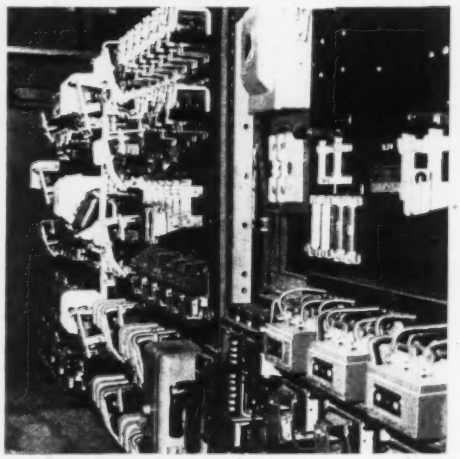
RELIABLE DRIVES must stand exacting demands of this revolver crane. G-E 200-hp motors and control are key to this application.

Electricity helps Garrison Dam keep round-the-clock schedule

G-E drives, still on the job after six years, are helping to harness Missouri River

At Garrison Dam near Bismarck, N. D., completely electrified equipment plays a vital role in keeping round-the-clock construction work on schedule. All electrical systems for the project's main stages were designed and co-ordinated by U. S. engineers, Peter Kiewit and Son Co., and Morrison-Knudsen Co. contractors—aided by G-E application engineering. This engineering teamwork resulted in maximum working capacity and fast, smooth operation.

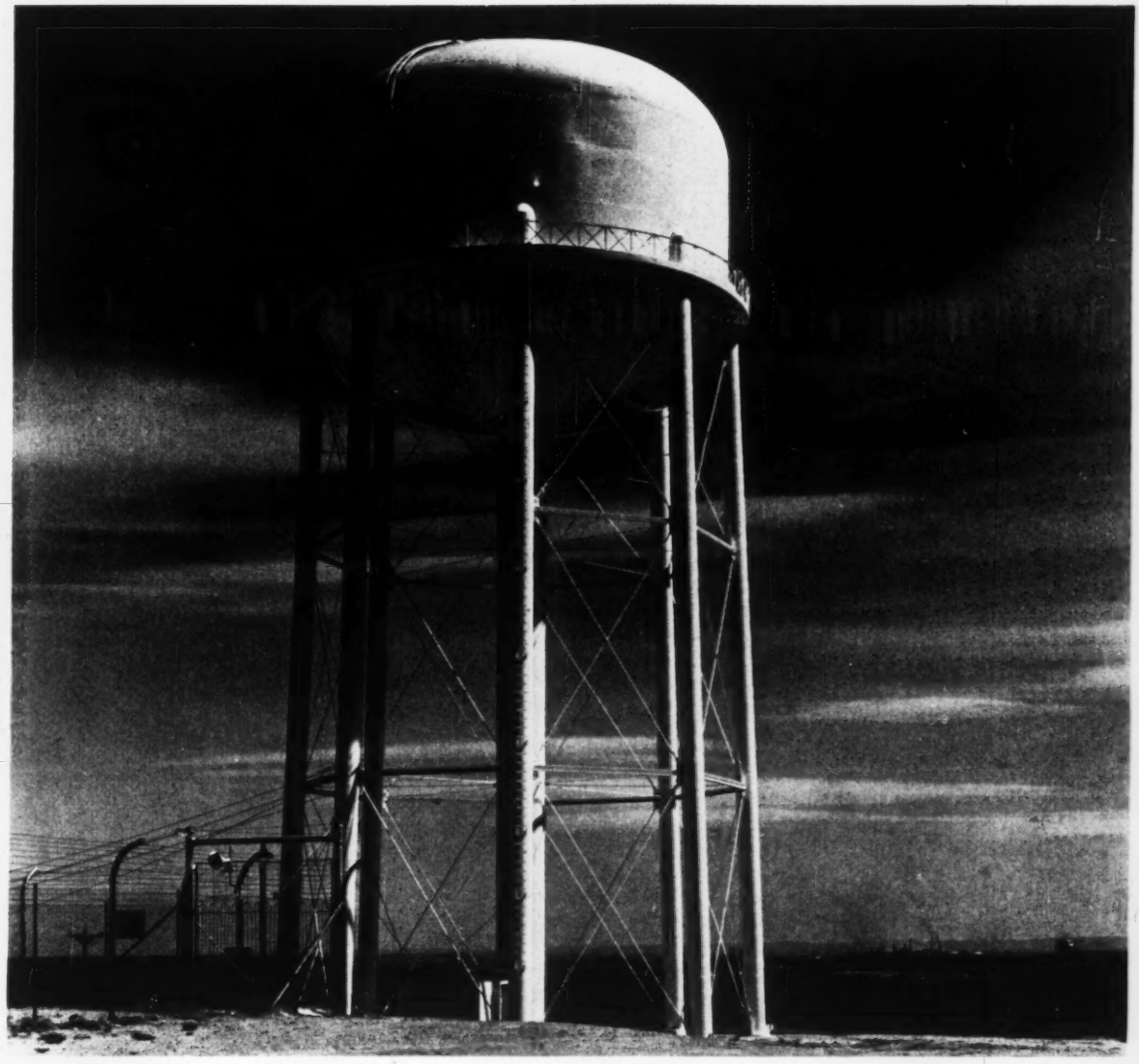
Let G-E application engineers help *you* get the most from your construction equipment through electrification—from the smallest drive to the largest power distribution system. Contact your nearest G-E Apparatus Sales Office. General Electric Co., Schenectady 5, New York. 664-31



CENTRALIZED CONTROL equipment on this compact G-E panel is mounted in the cab for simple one-man operation.

Engineered Electrical Systems for Heavy Construction

GENERAL ELECTRIC



Minimum Pressures Increased 60 Lbs. Per Sq. In.

Minimum distribution pressures were increased from a low of 10 lbs. per sq. in. to a minimum of 70 lbs. per sq. in. after a 500,000-gal. Horton elevated water tank was installed to serve the north side area in Pueblo, Colorado. In addition to eliminating extremely low minimum pressures, the Horton tank reduced pressure variations in the area. The Blackburn Engineering Company of Pueblo were Consulting Engineers on the job.

During the erection of this tank, the Chicago Bridge & Iron Company assigned a Field Welding Supervisor to inspect the job. The Field Welding Supervisor is a welding expert who assists the Foreman in checking every aspect of the welding. He supervises the cutting and grading of test plugs and helps magnaflux, x-ray or stress-relieve joints when called for in the governing specifications. If additional welders should be needed, he helps train and qualify them. This service is standard procedure on every Horton tank built . . . *at no extra cost to you.*

* * * *

Take advantage of Chicago Bridge & Iron Company Field Supervisory Service. Write our nearest office for estimates or quotations on a Horton elevated tank to improve your municipal water system.

CHICAGO BRIDGE & IRON COMPANY

Atlanta 3 . . . . . 2167 Healey Bldg.	Detroit 26 . . . . . 1541 Lafayette Bldg.	Philadelphia 3 . . 1652—1700 Walnut St. Bldg.
Birmingham 1 . . . . . 1596 N. Fiftieth St.	Havana . . . . . 402 Abreau Bldg.	Pittsburgh 19 . . . . . 3210 Alcoa Bldg.
Boston 10 . . . . . 1009—201 Devonshire St.	Houston 2 . . . . . 2128 C & I Life Bldg.	San Francisco 4 . . . . . 1584—200 Bush St.
Chicago 4 . . . . . 2199 McCormick Bldg.	Los Angeles 17 . . . 1556 Gen. Petroleum Bldg.	Seattle 1 . . . . . 1309 Henry Bldg.
Cleveland 15 . . . . . 2263 Midland Bldg.	New York 6 . . . . 3395—165 Broadway Bldg.	Tulsa 3 . . . . . 1647 Hunt Bldg.

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no other grader offers you this

UNBEATABLE COMBINATION

all-wheel drive

wakes up the front wheels

The front end of the ordinary motor grader is lazy, dead weight, contributing nothing to traction.

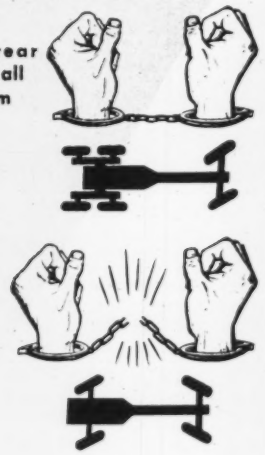
On the Austin-Western Power Grader, every pound rides on a driving wheel, contributing 100 per cent to traction.

all-wheel steer

frees the rear wheels

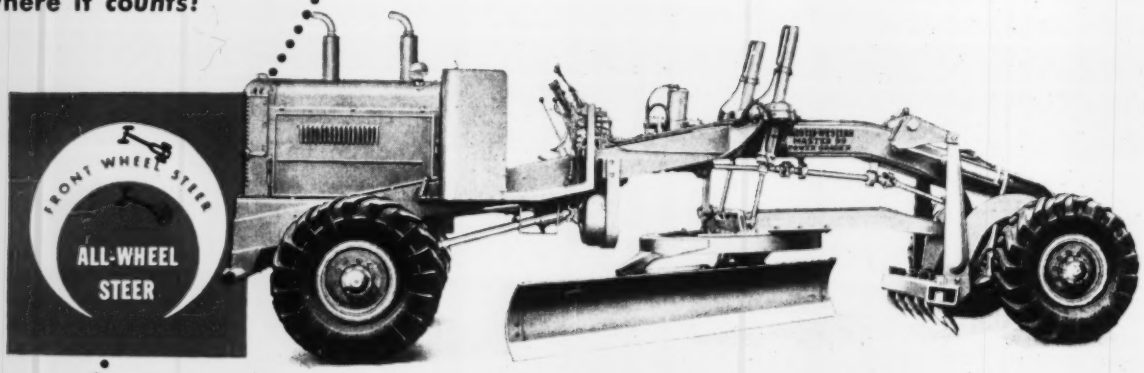
Non-steerable rear wheels slow-down all operations, make them more difficult.

Steerable rear wheels speed up every job, make it easy to do things impossible for other graders.



Twice the maneuverability

30% more POWER at the blade—more power where it *counts!*



No wonder . . . Austin-Western "88-H," "99-H" and Master "99" Power Graders, with their finger-tip hydraulic control and unequaled stamina, plus exclusive All-Wheel Drive and All-Wheel Steer, outpull, outmaneuver and just naturally outperform all others.

Austin-Western

Power Graders • Motor Sweepers
Road Rollers • Hydraulic Cranes

BALDWIN BLH LIMA-HAMILTON
Construction Equipment Division

Manufactured by
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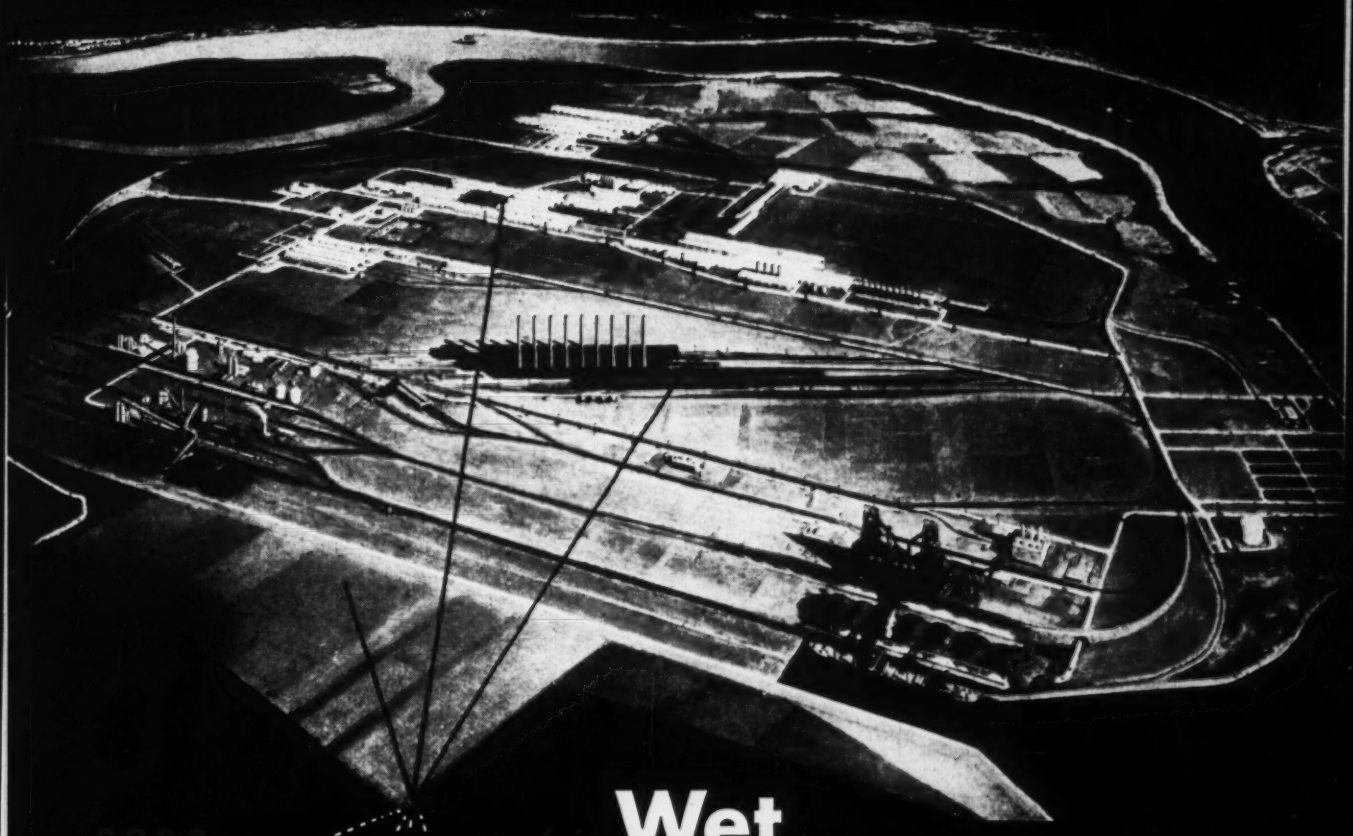
AURORA, ILLINOIS, U.S.A.

Fairless Works on the Delaware River—
Foundation, Grading and Dredging Contractor:
Walsh-Perini-Groves-Slattery
Companies, Morrisville, Pa.



Wet

3900 acres, most of it

Pumping was Problem #1 when it came to turning the farmlands of Morrisville, Pa. into the Fairless Works for United States Steel Corporation.

Moretrench Wellpoint Systems—by the mile—expertly planned, expertly installed, soon had the water under control. Excavation for coke ovens, power plant, blast furnaces, slip areas and other foundations went ahead on the double—IN THE DRY!

Twenty months later this enormous steel plant began production—a magnificent testimonial to the teamwork of the construction industry. From brains to brawn, Moretrench salutes every member of that team!

Moretrench Corporation

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Tampa 9, Florida

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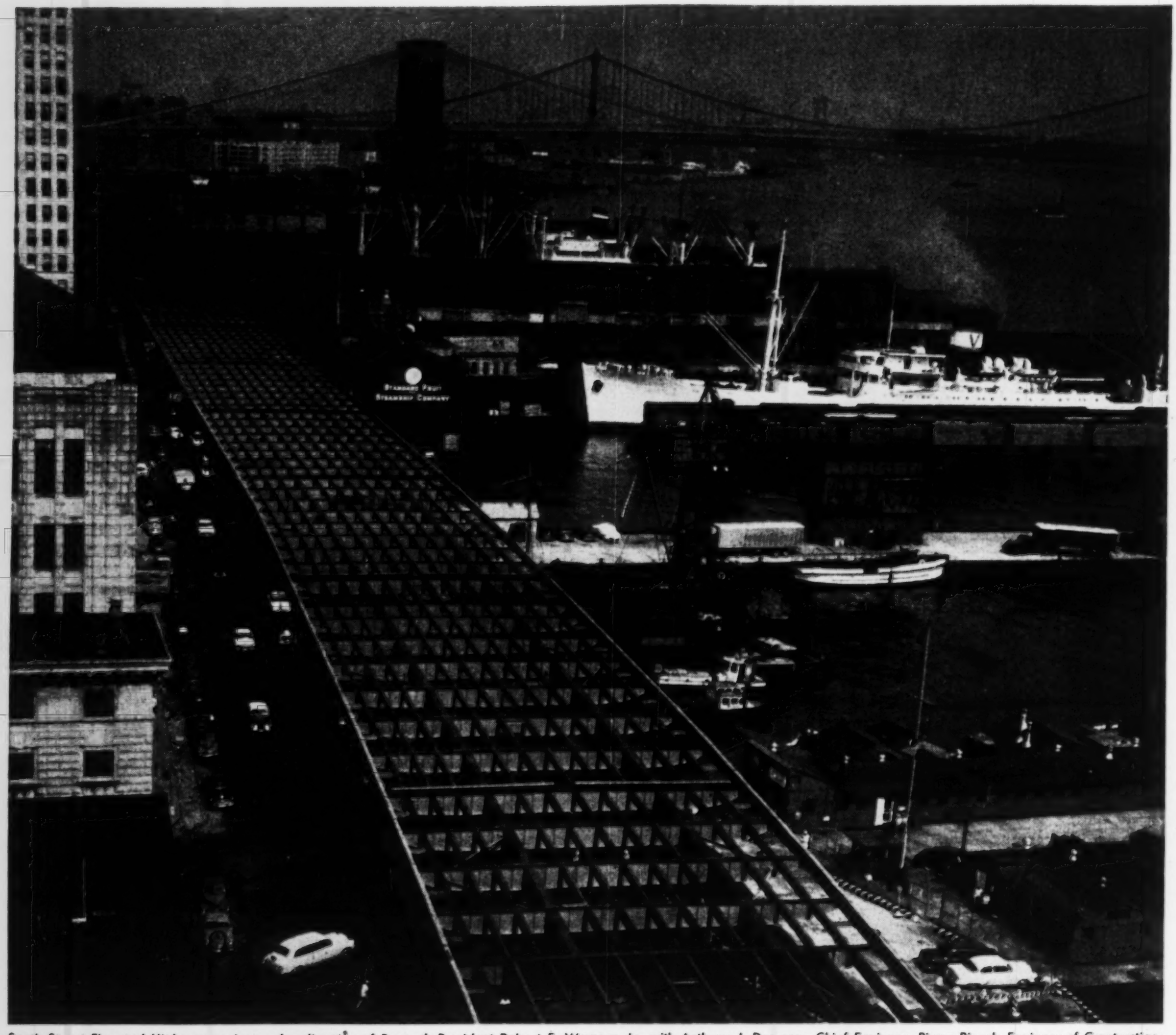
Canadian Representative: Geo. W. CROTHERS Limited, Toronto, Ontario



South Street Elevated Highway project under direction of Borough President Robert F. Wagner, Jr., with Anthony J. Donargo, Chief Engineer; Pincus Rizack, Engineer of Construction; John T. Carroll, Resident Engineer, for the Borough. Design by engineers of office of Borough President under supervision of Joseph C. Collyer, Engineer of Design, and Jacob M. Friedland, Engineer of Structures. General contractor: Fehlhaber Corporation; A. Burros, General Superintendent.

New Elevated Highway Along New York's East River

The 1.61-mile-long South Street Elevated Highway along the East River waterfront will greatly relieve traffic congestion in the Fulton Fish Market section of New York City. It will separate through traffic from waterfront commercial haulage, and connect the Franklin D. Roosevelt Drive with the Battery Park Underpass.

In constructing the 90-span superstructure of the elevated highway, Bethlehem fabricated and erected 15,582 tons of steel.

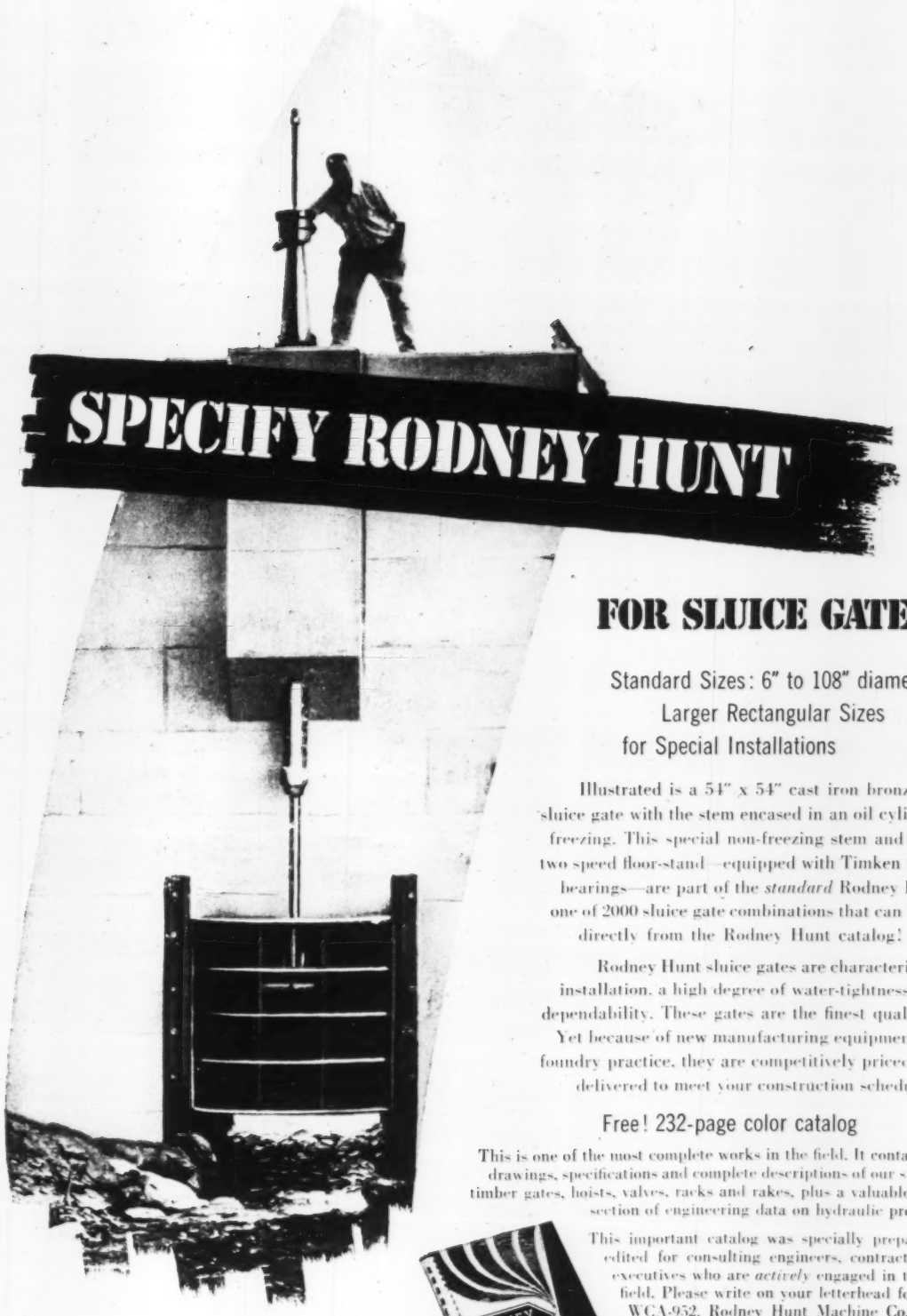
With the completion and opening to traffic of the South Street Elevated Highway, the island of Manhattan will be completely encircled by an express dual highway, except for a two-mile stretch along the Harlem river.

BETHLEHEM STEEL COMPANY
BETHLEHEM PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL



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Standard Sizes: 6" to 108" diameter
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for Special Installations

Illustrated is a 54" x 54" cast iron bronze-mounted sluice gate with the stem encased in an oil cylinder to prevent freezing. This special non-freezing stem and the selective two speed floor-stand—equipped with Timken tapered roller bearings—are part of the *standard* Rodney Hunt line—one of 2000 sluice gate combinations that can be ordered directly from the Rodney Hunt catalog!

Rodney Hunt sluice gates are characterized by easy installation, a high degree of water-tightness and complete dependability. These gates are the finest quality obtainable! Yet because of new manufacturing equipment and modern foundry practice, they are competitively priced . . . and delivered to meet your construction schedule!

Free! 232-page color catalog

This is one of the most complete works in the field. It contains photographs, drawings, specifications and complete descriptions of our sluice gates, timber gates, hoists, valves, racks and rakes, plus a valuable 28-page section of engineering data on hydraulic problems.

This important catalog was specially prepared and edited for consulting engineers, contractors and other executives who are *actively* engaged in the water control field. Please write on your letterhead for Catalog WCA-952. Rodney Hunt Machine Co., 86 Lake St., Orange, Mass., U.S.A.

RODNEY HUNT®

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Manufacturing Engineers Since 1840

Research and Development bring you this finer-than-ever pipe

You can't better a product like cast iron pressure pipe—with its unparalleled record of long life, economy and efficiency—by waving a wand. Yet the story of how the best product in its field has been made *still better* can be told in a paragraph.

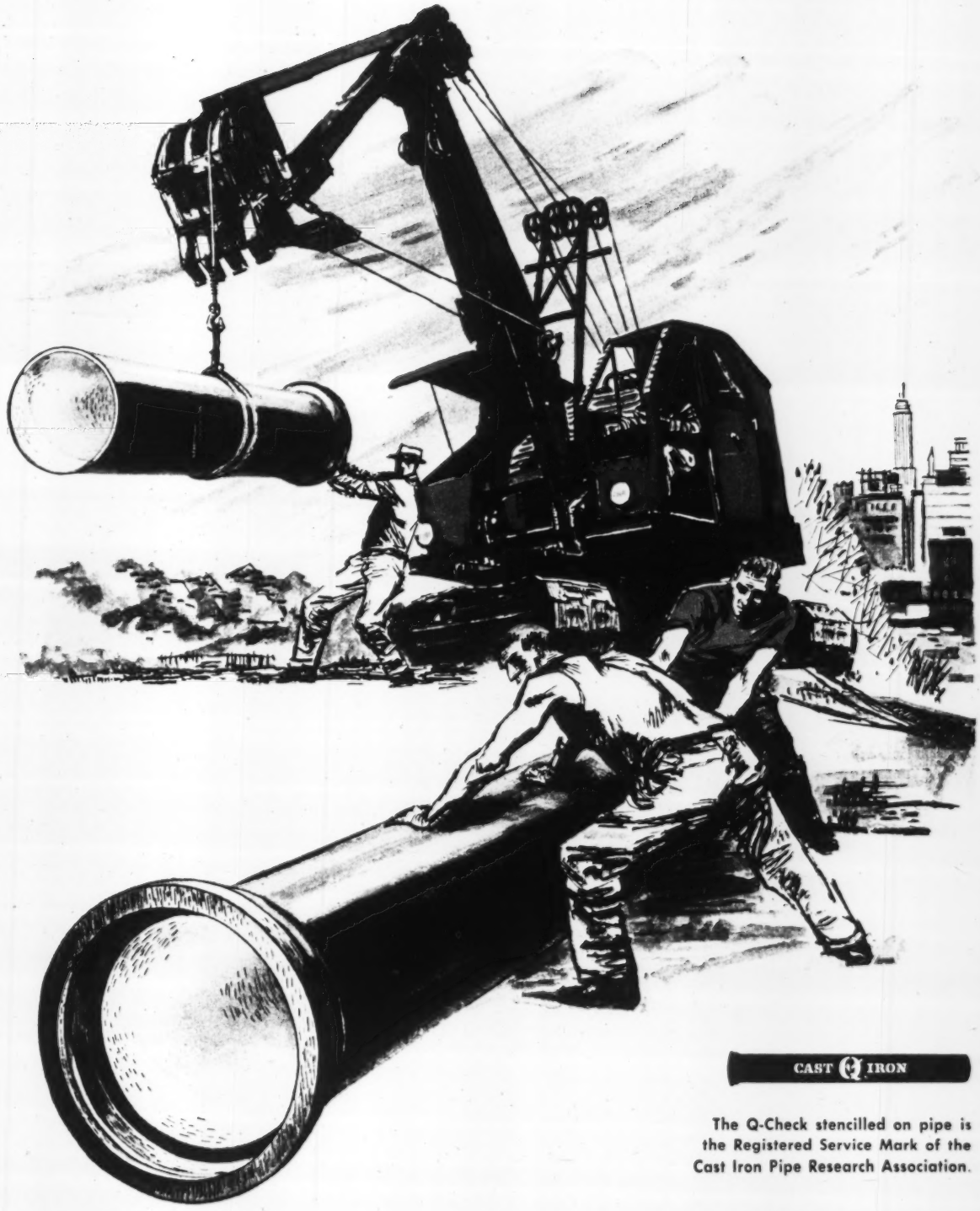
Modernized cast iron pipe is a result of the sum total of recent product and process improvements attained by research and development.

It is centrifugally-cast and, when needed, centrifugally cement-lined. It is tougher, stronger, more uniform in quality. It is tuberculation-proof with sustained carrying capacity for the life of the pipe.

If you want the most efficient and economical pipe ever made for water distribution, your new mains will be laid with *modernized* cast iron pipe with either mechanical or bell-and-spigot joints. Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Ave., Chicago 3.

This cast iron water main, uncovered for inspection, is in good condition after over a century of service in Detroit, Mich. —one of more than 45 cities with century-old water or gas mains in service.

Modernized **cast iron**



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The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.

pipe *for Modern Waterworks Operation*

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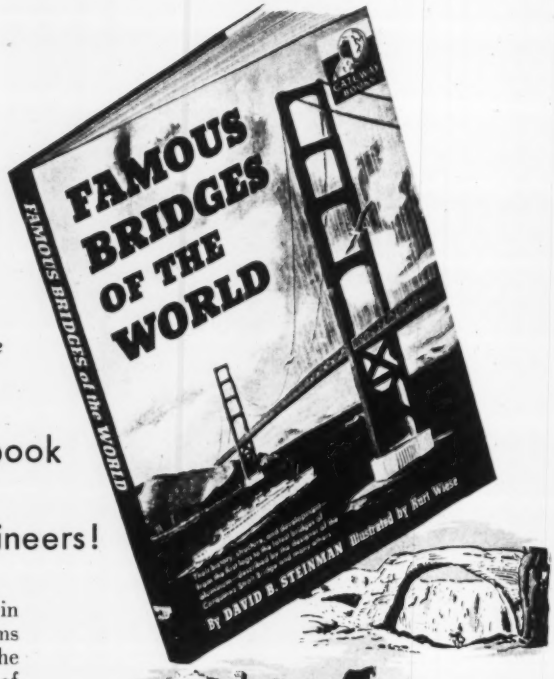
By David B. Steinman,
designer of the Carquinez Strait Bridge and many notable suspension bridges.



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The perfect gift for the families of engineers!

Here is the fascinating adventure of bridge building told in a lively narrative style that will thrill everyone with dreams and imagination. From the first log across a stream to the magnificent engineering miracles of today, the history of bridges and the men who build them stirs the mind and kindles the ambition.

For instance, there is the remarkable story of John Roebling, the young immigrant who, by his invention of wire rope, made possible today's huge suspension bridges; and of his son, Washington Roebling, who completed the Brooklyn Bridge.

Along with the adventure and the drama, the author reveals, in interesting and easily understood language, details of bridge structure and development. Descriptions of the suspension bridge, the arch bridge, the truss bridge and the cantilever bridge provide the answers to those eternal "Whys?" and "Hows?" of active minds.

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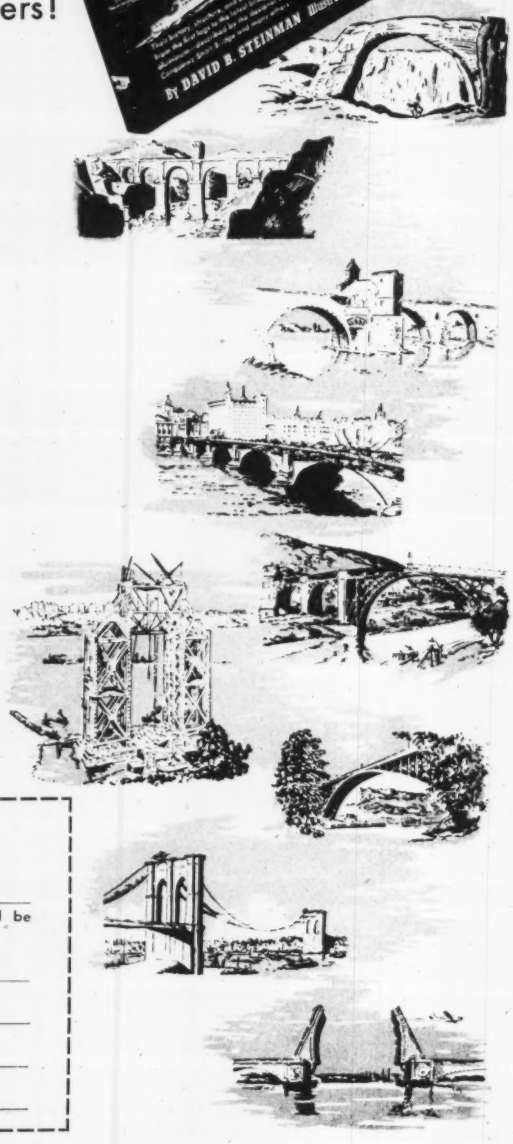

Dr. David B. Steinman
117 Liberty Street, New York 6, New York

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Kindly have the books inscribed with the following names:

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I am enclosing my check for $_____ and understand the books will be sent postage paid.

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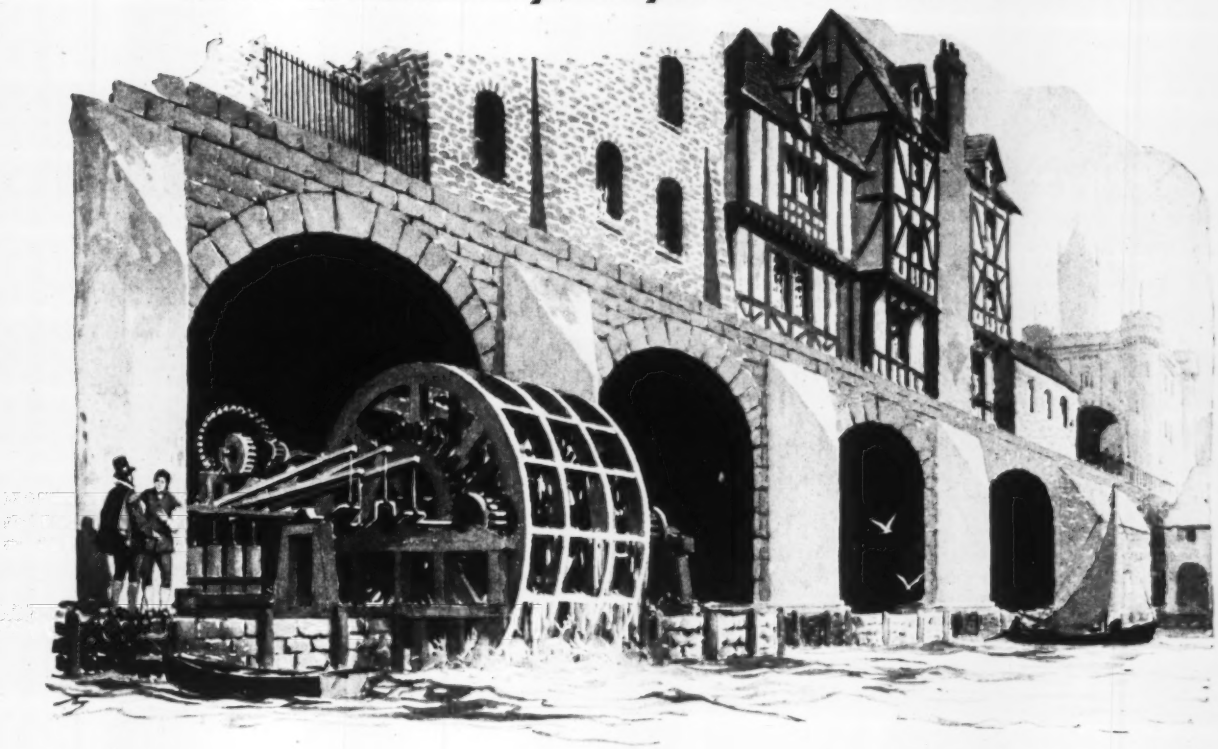
in 1582 *when this machine pumped London's Water*



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In this country alone there are systems that would shame London's great contribution, even in our smallest towns.

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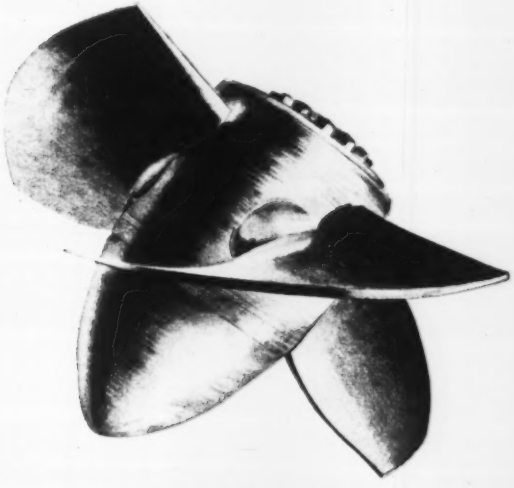

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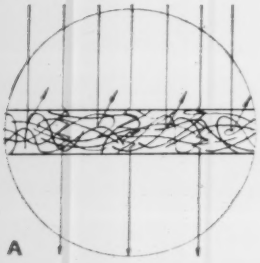
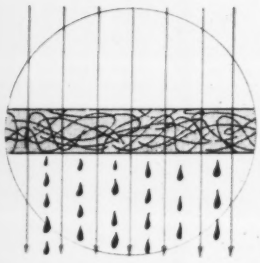


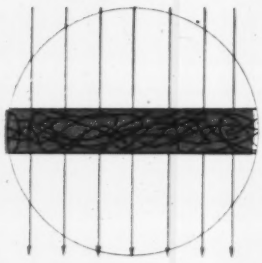
Diagrammatic enlargement of cross section of paper with high strength but low transparency. Fibers are surrounded by air, which has different index of refraction. Many light rays are bent back and do not get through.

SAME PAPER
TRANSPARENTIZED WITH FLUID MATERIAL



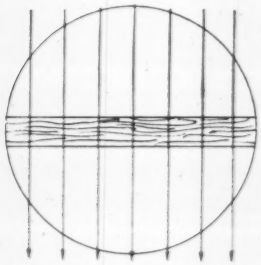
Same paper as "A", filled with oil or other fluid material, giving spaces between fibers same index of refraction as fibers. Reflection and refraction of light are reduced and paper becomes highly transparent. But transparency is not permanent because *fluids* "bleed" out.†

SAME PAPER
TRANSPARENTIZED THE ALBANENE WAY



Same paper as "A", filled with an inert synthetic resin, with correct index of refraction. This is how Albanene is made. Its transparentizer does not "bleed" out. Albanene holds its color and strength and is permanently transparent.†

PAPER TRANSPARENTIZED BY
CRUSHING AND BEATING FIBERS



Papers are also transparentized at the mill by a "beating" process. The fibers are crushed, flattened and compacted. Reflection and refraction of light are reduced. But the process weakens the fibers and the strength of the transparent paper is low.

More than 15 tests are made during production of Albanene. For example, each production roll is tested for pencil "take", for pencil erasing and the taking of drawing ink. To eliminate human variables, pencil lines are drawn by machine. In this way you are assured of the uniformity of working surface so much desired by draftsmen, and assured of a paper that makes cleaner, sharper prints . . . now or a generation later. Ask your K&E Distributor or Branch for further information.

† Prove this by making the "drafting tape test" Press a short piece of drafting tape on fluid-transparentized paper, and another on Albanene. Strip them off the next day and examine both papers. Notice that enough fluid has drifted out of the ordinary paper into the tape to destroy much of the transparency. And notice that Albanene is not affected. What drafting tape does over night, time will do naturally.

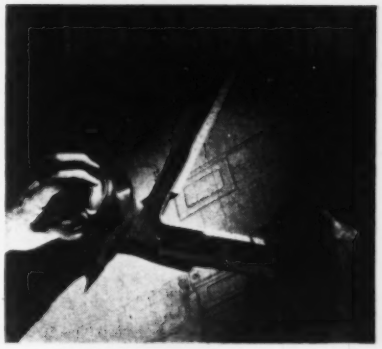
*TRADE MARKS ®

Transparent . . . and Better!

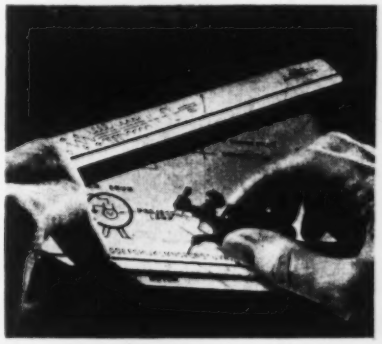
The Right Angle

AVAILABLE IN MANY FORMS FOR MANY USES

Albanene comes in 20-yard and 50-yard rolls in various widths and in three different weights. For those who like the convenience of cut sheets, a new Albanene package has been designed. It strongly protects the paper in shipment and storage, and may be opened without mutilating the container, thus serves as a dispenser in drafting room or stock room. Albanene cut sheets can be supplied imprinted to your specifications.



Once you've discovered the pleasure of drawing on Albanene, the next logical step is to save time, trouble and eyesight with a K&E PARAGON* Drafting Machine. You control your calibrated straight edge with a light touch of one hand, for parallel lines and lines at any angle.



Make your lettering letter-perfect and save wear and tear on your nerves by using a LEROY* lettering outfit. Template grooves guide your pen so the finished result looks like printers' type, and the whole process is relaxing. There's a wide choice of sizes, styles and symbols.

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NOVEMBER 1953

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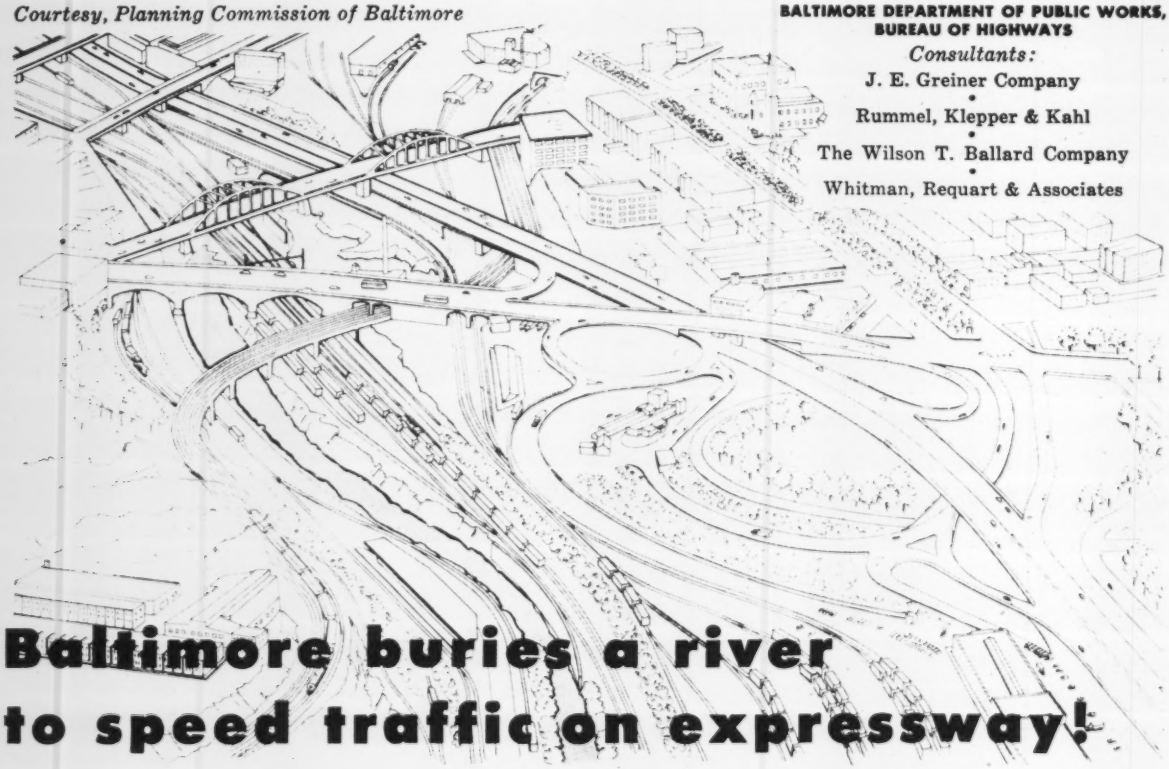

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Baltimore buries a river to speed traffic on expressway!

Baltimore's new Jones Falls Expressway is designed to facilitate traffic in and through the city. It's one of several long-needed steps which will relieve the type of congestion many cities are facing. The highway must pass through the center of town, adjacent to the Pennsylvania Railroad Station, the U. S. Parcel Post Building, and over the tracks of the Pennsylvania and B & O railroads and other valuable property. To accomplish this objective, Jones Falls is being boxed, and the highway built over it. Though a small stream in dry weather, Jones Falls becomes a rushing torrent during flash floods, and flows between walls as high as 30 feet. The Jones Falls Expressway design plans include a number of new bridges, the rebuilding of others, underpinnings, underpasses, and construction along steeply sloped valley walls.

The borings to bedrock – 215 in all – were made by Giles, which specializes in marine borings, undisturbed soil sampling, large calyx holes in rock, and all engineering test boring work.

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NOVEMBER 1953
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Characterized as the world's longest and safest toll road, the New York State Thruway is being pushed rapidly to completion. In spite of rough terrain in certain stretches and difficult foundation conditions in others, grades are not greater than 3 percent nor curves than 3 deg. Concrete pavements 9 in. thick, supported on at least 4 ft of frost-free material, provide two- and three-lane roadways separated by a mall and designed to be safe for speeds of 70 mph. The Thruway is scheduled for completion between New York and Buffalo in 1955 at a cost of over half a billion dollars.

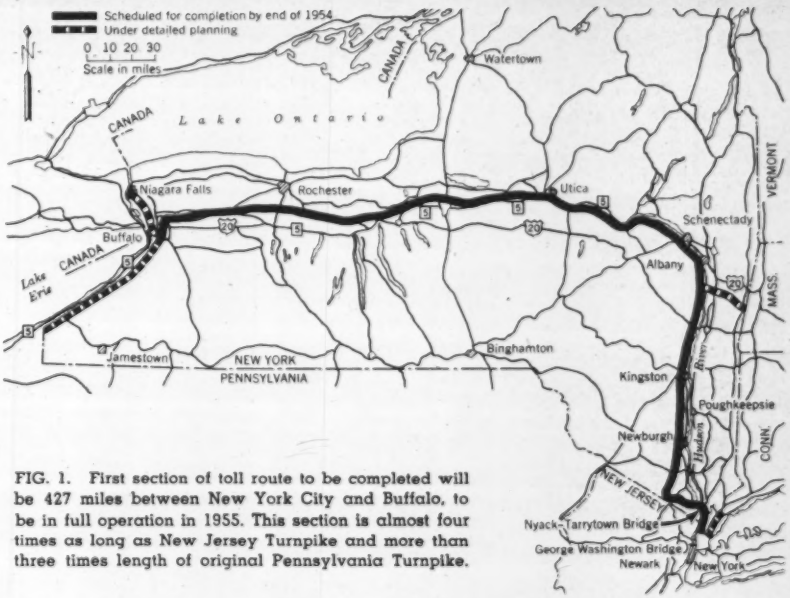


FIG. 1. First section of toll route to be completed will be 427 miles between New York City and Buffalo, to be in full operation in 1955. This section is almost four times as long as New Jersey Turnpike and more than three times length of original Pennsylvania Turnpike.

NEW YORK STATE THRUWAY

Authority pushes work on 427-mile New York–Buffalo section

B. D. TALLAMY, A.M. ASCE, Chairman, New York State Thruway Authority, Albany, N.Y.

The idea of constructing an expressway through the economic heart of New York State, from New York City to Buffalo, was born more than 100 years ago. The pressures caused by our state's population and economic growth, the transportation problems nurtured by two world wars, and the amazing increase in motor traffic, kept rekindling the idea periodically until finally, in 1942, the general location of the Thruway received legislative approval. This 1942 law, however, only authorized the State Department of Public Works to prepare plans for the project.

Two years later, in 1944, the state legislature, urged by Governor Dewey, authorized the Public Works Department to start construction on as broad a scale as regular highway funds permitted. Upon the conclusion of World War II, the first ground was broken in 1946 at Liverpool, near Syracuse. A few other contracts were let that year for Thruway work in other sections of the state. At that time, incidentally, the idea was to maintain the Thruway as a free facility in the state's regular highway system.

It soon became evident that this process of squeezing funds from the relatively modest state highway budget could not get the Thruway built fast enough to ease the state's growing traffic headache. We needed the Thruway immediately to lift the traffic burdens from outmoded parallel roads and to provide traveling space for the soaring number of motor vehicles.

Center span of New York State Thruway's Hudson River Bridge between Tarrytown and Nyack is seen in artist's sketch above. This 60-million-dollar structure, located about 14 miles north of New York City, will be one of world's largest of its type. Motorist's view of this bridge, at left, shows spaciousness of design and good sight distance.

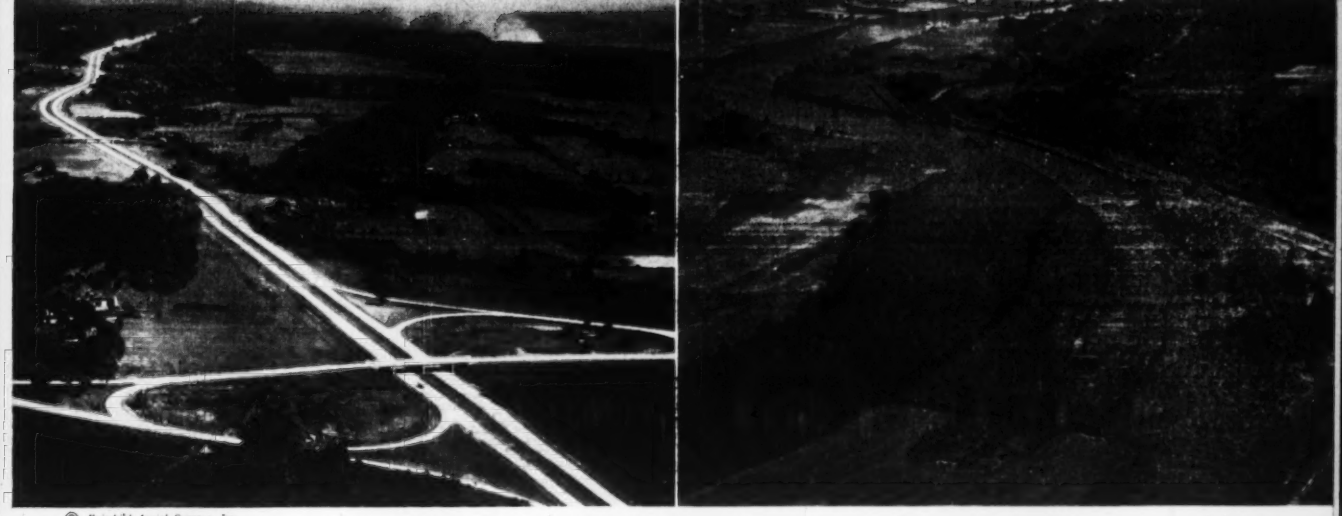
Accordingly in 1950 Governor Dewey appointed a special committee to canvas the Thruway program, and to recommend a method by which it could be accelerated. That group conceived the Thruway Authority plan. It recommended the creation of an independent authority with power to issue bonds to build, operate, and maintain the cross-state expressway on a "pay-as-you-ride" basis through the collection of tolls and the issuance of special highway-user permits. The state legislature immediately endorsed the proposal, and Governor Dewey appointed the members of the Thruway Authority in March of 1950.

The Authority was empowered to issue 500 million dollars worth of bonds. To help keep interest costs at a minimum, the people of New York State approved a constitutional amendment in the fall of 1951 permitting the state to place its credit behind Thruway bonds. That amendment will save at least 100 million dollars in interest costs.

So far, 250 million dollars worth of bonds have been sold. The first 125-million-dollar issue was sold in May 1953, and the second in August 1953. From these funds we are paying for construction. The Authority will also repay to the state all the money spent on Thruway projects before the Authority was created.

Actually 500 million dollars will not be enough to build the entire Thruway (Fig. 1). Consequently all efforts are being directed towards completion of the 427-mile section from Buffalo to New York, which is the financial heart of the Thruway system. In the meantime detailed construction plans are being prepared, and methods studied, for financing the other authorized Thruway sections. These will extend the New York-to-Buffalo expressway from Buffalo to the Pennsylvania border, from Buffalo to Niagara Falls, from a point near Albany to the Massachusetts border, and from New York City to the Connecticut line. Neighboring states are building or planning to build superhighways of their own to connect with New York's Thruway system. This Thruway will be paid for by the motorists and truckers who use it, without adding any burden to the state treasury.

It has not yet been decided what the exact tolls will be. However, after a 19-month study, the consulting engineers recommended that passenger cars be charged on the basis of 1 cent a mile, trucks on an average basis of 3.3 cents a mile, and buses on the basis of 3.5 cents a mile. In addition, they proposed that owners of passenger cars registered in New York State be permitted to buy an annual-use permit for $10, which would entitle them to unlimited use of the roadway and cut in half the regular 50-cent toll on the big Hudson River bridge between Tarrytown and Nyack. The authority, however, has not yet established the toll schedule, nor will it do so until the total costs of construction are more firmly established. It is determined to keep tolls at the lowest possible amount commensurate with sound business practice.



© Fairchild Aerial Surveys, Inc.

Aerial views of Thruway show grade separation near Saugerties, N.Y. (left), and relocation of Mohawk River near Canajoharie, N.Y., to make room for Thruway (right).

Since March 1950, when the Thruway Authority was created, the construction program has made tremendous progress. And this has been accomplished despite critical shortages of structural steel and, in some instances, of trained manpower and certain materials. We now have all of the 427-mile route from Buffalo to New York City under construction and a great many miles are in use as temporary, free facilities.

We are now sufficiently well along with the work to be confident that by 1955 New York's 4 million motor vehicles and thousands upon thousands of visiting motorists will be making the Thruway one of the world's major transportation systems.

To give some idea of the magnitude of the project, which the staff likes to call "the Thruway—Believe It or Not," a few comparisons can be given.

We expect—and our estimates are conservative—that a total of 55 million trips will be made on the expressway in its first full year of operation with all the extensions in service. That is more than twice the total counted on the Pennsylvania Turnpike in its first 10 years of operation.

The New York-Buffalo section is almost four times as long as the New Jersey Turnpike, and more than three times as long as the original Pennsylvania Turnpike. The steel being used in this section, exclusive of bridges, would be enough to build a double-track railroad all the way from New York to Washington, D.C. And if the blueprints drawn for this section were placed end to end, they would reach all the way from Buffalo to Albany, or more than 300 miles.

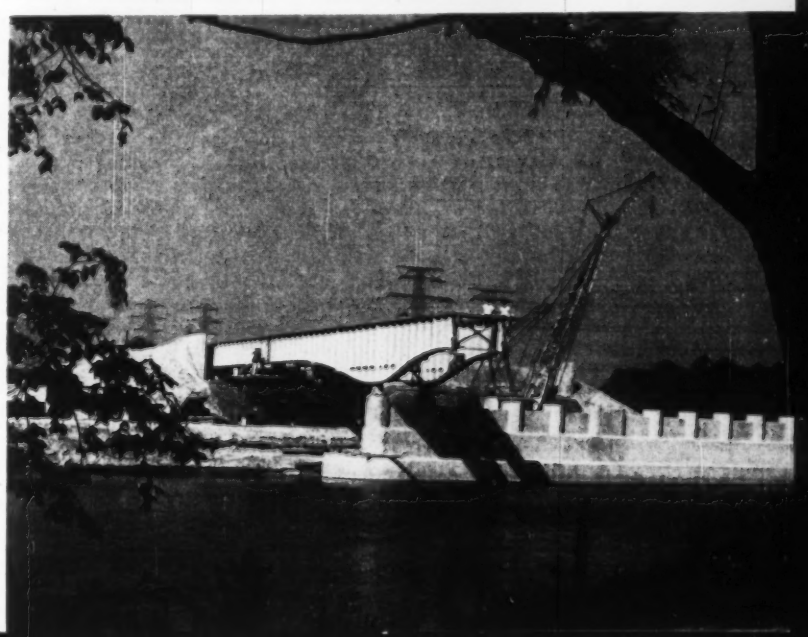
There are other interesting features. Nearly one mile of interchange access roads or approaches, or relocations of existing roads, is being built for every mile of center-line Thruway between New York and Buffalo. In other words, more than 800 miles of new, modern highway are actually being built.

One of our most difficult jobs has been to make the public realize the vastness of the project. Despite its immensity, and the fact that its operation is of necessity big business, the Thruway Authority has a relatively small staff.

The Thruway Law authorized us to make the fullest use of existing state departments, and also permitted us to utilize the services of private consultants and private engineering firms wherever needed. We have done this extensively and as a result are handling this tremendous project without building a large, new state agency, parts of which would duplicate the functions of, and compete for personnel with, other state departments and agencies. This plan also has provided us with highly skilled assistance that would not otherwise have been available.

Particular credit must be given to the State Department of Public Works, which has devoted so much of its time and talents to Thruway work. And we have not hesitated to call on other state agencies and departments whenever their particular functions or manpower were needed. They have all responded unselfishly.

Bridge here seen under construction will carry Thruway over Onondaga Lake outlet, just west of Syracuse, N.Y. Anchor span is 125 ft long, and distance between piers is 200 ft, of which 125 ft is suspended span.



Highway use determines economic

ELMER B. ISAAK, A.M. ASCE, Engineer in Charge of Engineering Surveys, Madigan-Hyland,

In creating the Thruway Authority in March 1950, and providing for the guarantee of the Authority's bonds by the State of New York, it was necessary to fix a limit on the Authority's borrowing capacity. Taking into account the construction conditions and cost levels of 1949, and the initial information then available on the Thruway itself, a $500,000,000 limit on the Authority's borrowing power was established, as pointed out by Mr. Tallamy in his article in this issue.

One of the first acts of the Authority was to authorize a detailed traffic and economic study. This study crystallized the nature of the fees to be charged for the use of the Thruway, and presented the first comprehensive picture of the route's revenue potential. This study was based on one of the most comprehensive traffic surveys ever undertaken. Vehicles were counted and drivers interviewed on all the principal state highways at 49 check points, including 41 on main state highways, 5 on bridges, and 3 on ferries. Over 1,500,000 vehicles were counted and nearly 400,000 questionnaires were answered, the bulk of them through roadside interviews.

Analysis of the facts so obtained made possible an estimate of future Thruway traffic and also shed important light on its probable characteristics. For example, it was established that the great bulk of the expected traffic will travel on the Thruway for relatively short distances, and that long-distance trips will be a negligible factor except for heavy trucking. Passenger-car trips are expected to average only 34 miles, with 80 percent of all such trips being less than 50 miles. Fewer than 3 percent will exceed 200 miles. (See Fig. 1.) These estimates were borne out by actual facts uncovered in the Thruway traffic survey. Of the 194,562 automobiles counted on main state highways on a typical weekday, only 150 were found to be traveling between New York and Buffalo.

Light trucks show an even greater tendency toward short trips than do passenger cars, as 87 percent of the trips will be for less than 50 miles. Heavy trucking, however, falls into a different category. The average heavy-truck trip on the Thruway is estimated at 94 miles, but even in this class 83 percent of all trips will be under 150 miles.

These figures emphasize the role of the Thruway as a series of sections connecting adjacent population centers, rather than as a high-speed funnel channeling great streams of traffic from one end of the state to the other. Every survey dealing with the subject for 15 years has shown the preponderance of short-trip traffic in populated areas, and this will be the basic character of traffic on the Thruway.

Trip Frequencies Analyzed

Another interesting analysis of traffic characteristics dealt with the frequency of travel by individual Thruway users. Because of the proposal advanced that an annual permit, good for unlimited use, be issued, it was essential to determine the extent to which individual vehicles might make repeated trips on the Thruway. The basis for this information was a question added to the traffic survey interviews, "How many times a year do you make this trip?" The answers to this question produced some startling results.

Of the total annual passenger-car trips considered divertible to the Thruway, it was found that 25 percent would be made with commuter frequencies (Fig. 2), and that this 25 percent of the total volume would be piled up by less than 0.5 percent of the individual drivers using the facility during the year. This finding becomes more comprehensible when it is noted that one steady commuter makes at least 250 round trips, or 500 one-way trips, a year. A further group of regular users, those making two to four round trips per week, will account for 15 percent of the total passenger-car volume, even though only about 0.6 percent of the individual vehicles using the Thruway in a year will be involved.

In order to discuss the subject of trip frequencies more precisely, it was necessary to coin a term to designate the trips made by a particular vehicle between two specific points, regardless of the number of times such a trip is repeated. The term chosen was "vehicle-run" (Fig. 2). This unit can be mathematically computed from a trip frequency survey, whereas the number of individual vehicles cannot actually be determined because it is not known how many different sets of points a single vehicle may travel between in the course of a year. One "vehicle-run," then, means all the trips made by a single vehicle between the same two points in the course of a year.

In discussing trips made with very high frequencies, the number of vehicle-runs nearly corresponds with the number of vehicles, since it is unlikely that any one vehicle will be traveling between more than one pair of points on a commuting basis. On more casual trips, however, a single vehicle can of course make a

feasibility

Consulting Engineers, New York, N.Y.

large number of different vehicle-runs.

Continuing the analysis of passenger-car trip frequencies expected on the Thruway, it was found that trips made with very few, if any, repetitions reveal characteristics equally as interesting as those made by commuters. See Fig. 2. Unrepeated trips, that is, those trips made only once a year, constitute 14 percent of the anticipated passenger-car volume on the Thruway, but these trips represent a big 72 percent of all the vehicle-runs to be made during the year. Another 10 percent of the passenger-car volume consists of trips made from two to four times a year, representing 16 percent of the vehicle-runs. Nearly half of all trips will be made with frequencies in the middle groups of from once a month to four times a week.

The significant point is that there will be a very large number of occasional users of the Thruway, but that a disproportionately large segment of the traffic volume will be built up by a relatively small number of regular users.

Truck traffic shows an even greater tendency to repetitive trips, with heavy trucks contributing a much greater concentration of trips repeated from one to four times per week.

A correlation between frequency and distance of travel was also revealed by the data. (See Fig. 3). For passenger cars the average length of trips made oftener than five times a week was about 20 miles, but trips made only once a year averaged 170 miles in length.

Utilization of the basic traffic facts afforded by the origin and destination survey made it possible to arrive at well-founded estimates of

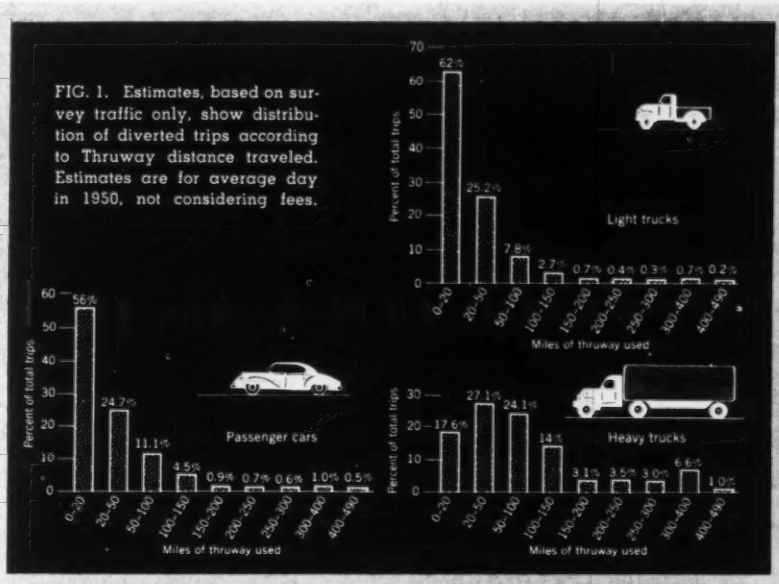


FIG. 1. Estimates, based on survey traffic only, show distribution of diverted trips according to Thruway distance traveled. Estimates are for average day in 1950, not considering fees.

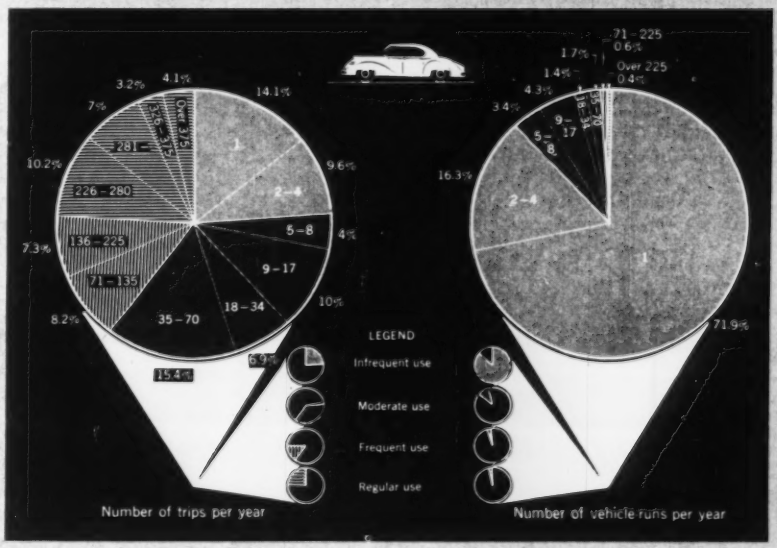
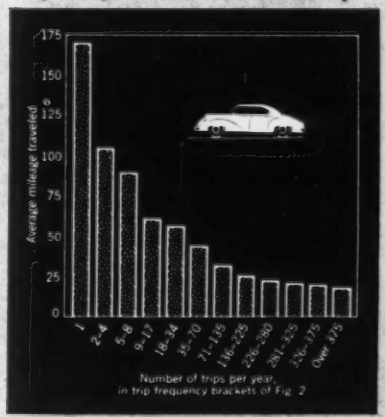


FIG. 2. Number of individual passenger-car trips per year diverted to Thruway are compared with number of vehicle-runs per year by trip frequency groups. Estimates are for year 1950, based on survey traffic only, not considering fees. For example, from circle at left it is seen that those making 1 trip per year will constitute 14.1 percent of total yearly Thruway passenger-car traffic. However, circle at right shows that those making 1 yearly vehicle-run will constitute 71.9 percent of the yearly vehicle-runs. Vehicle-run is term coined to indicate all the trips made by a particular vehicle between two specific points in one year, regardless of the number of times such a trip is repeated. In other words, a comparatively few drivers will roll up a disproportionately large mileage on Thruway.

FIG. 3. Average total distance traveled, in trip frequency brackets of Fig. 2, is shown for passenger cars diverted to Thruway.



the traffic considered divertible to the Thruway. The methods used were both painstaking and time consuming, and are not readily susceptible of detailed description here. Suffice it to say that due consideration was given to the usual factors of comparative time and distance, competitive highways, the advantages of an uninterrupted route with expressway standards, safety, and other features entering into the choice of a route by a driver. Seasonal and daily variations in traffic were considered, to expand the survey results to an annual basis.

Toll System Studied

Particular attention was paid to the toll aspects of the Thruway, both from the standpoint of establishing reasonable levels and types of fees and from the standpoint of developing a practical system of collecting such fees. It is not the objective to charge all the traffic will bear, but rather to secure a revenue from the users of the Thruway that will enable the project to support itself.

A new element in the toll picture was the proposal of an annual permit, to be sold for a lump sum, which would be good for unlimited use of the Thruway during the year. This system affords the regular user a travel bargain, and also attracts to the facility some traffic that would not otherwise use it. Investigation showed, however, that the permit system cannot be applied to trucks, as it is impossible to fix a fee that is fair to all trucks and still will produce the necessary revenue for the Thruway. Many individual trucks on the Pennsylvania Turnpike pay aggregate tolls of a thousand dollars or more a year. A fee of that magnitude would be required to secure adequate revenue from regular heavy-truck users of the Thruway, and yet it would obviously be impossible to set any such amount as a permit fee. For this reason the permit scheme was eliminated so far as trucks are concerned.

Annual permits will be available, however, for private passenger cars registered in New York State. The rate recommended by the engineers, though not yet adopted by the Authority, is $10 a year. Permits will entitle their holders to use the Thruway as much as they please without extra charge, except that a minimum toll of 25 cents will be paid by all vehicles crossing the Hudson River Bridge at Tarrytown.

Vehicles not holding permits will pay for each trip at rates varying with the type of vehicle and the distance traveled. The tolls will be comparable with those charged on existing turnpikes, and will be collected principally at the exit interchanges. The rate recommended by the engineers for passenger cars is 1 cent a mile.

When they enter the Thruway, drivers will pick up a toll ticket showing their vehicle class and point of entry, and at the exit they will surrender the ticket and pay the proper toll.

In areas near New York City and Buffalo, tolls will be collected at a few barrier-type stations instead of at interchanges. This method was considered more suitable in these heavily built-up areas because the interchanges will be very close together there and the cost of building collection facilities and maintaining them at every exit was considered excessive. Some free use of the Thruway for very short trips will therefore be permitted in these areas, but the revenues lost are considered to be less than the costs of collecting them. The barrier type of toll collection is feasible in these sections because they are at the ends of the system. Continuation of the barrier system throughout the length of the Thruway was not considered desirable because of the excessive number of stops that would be required of long-distance travelers, and because revenue losses would be excessive.

Very close attention was paid to the development of the most foolproof toll collection system that could be devised, and we believe that major advances in the art have been made as a result of more than a year's intensive research in this field. The equipment now being manufactured is almost revolutionary in some of its concepts, but this is another story in itself.

On the basis of the toll collection framework adopted, various rates of toll and their effects on traffic were studied. Particular study was given to the monetary savings available to trucks because of the superior type of artery, and a rate schedule was proposed based on operating savings resulting from only three things — reduction in fuel cost, reduction in vehicle maintenance cost, and reduction in tire wear. All the savings accruing to trucks because of time savings, increased utilization of equipment, heavier loads, and the possibility of turn-around trips, will be in the nature of a bonus to the truckers. The truck tolls recommended as a result of these studies were 1.0 cent a mile for light trucks and from 2.0 to 5.0 cents a mile for heavy trucks. These rates are slightly lower than those in force on the Pennsylvania Turnpike.

Taking into account the recommended level of tolls, the final estimates of Thruway traffic were developed. These estimates reflected not only the vehicles expected to be diverted from existing arteries, but also the effects of increased travel resulting from the existence of the Thruway project. Careful estimates were developed of probable future trends affecting Thruway traffic volumes, including the growth of population and motor-vehicle registrations, and annual volumes were projected for a period of years into the future.

Traffic and Revenue Estimated

For the first full calendar year of Thruway operation on the stretch between New York and Buffalo — 1955 — the estimated traffic volume is 34 million trips, of which 14 percent will be commercial vehicles and the rest passenger cars. Of the 29 million passenger-car trips, 20 million are expected to be made on permits, but the number of annual permits sold may not exceed 200,000 in the early years.

If recent precedent is followed and no serious economic disturbance occurs, a very rapid growth of traffic should be seen over a period of ten years following the opening of the Thruway, even without taking into consideration any possible extensions of the system. For purposes of estimating, a conservative growth factor of 45 percent in ten years has been used, but the growth rate of truck traffic is expected to be substantially greater than that of passenger cars, so that commercial trips will account for about 19 percent of the total traffic by that time.

By applying the recommended rates for fees and charges to the estimated traffic, the prospective gross revenues from tolls have been determined. These estimates range from $19,000,000 in the first full year to a

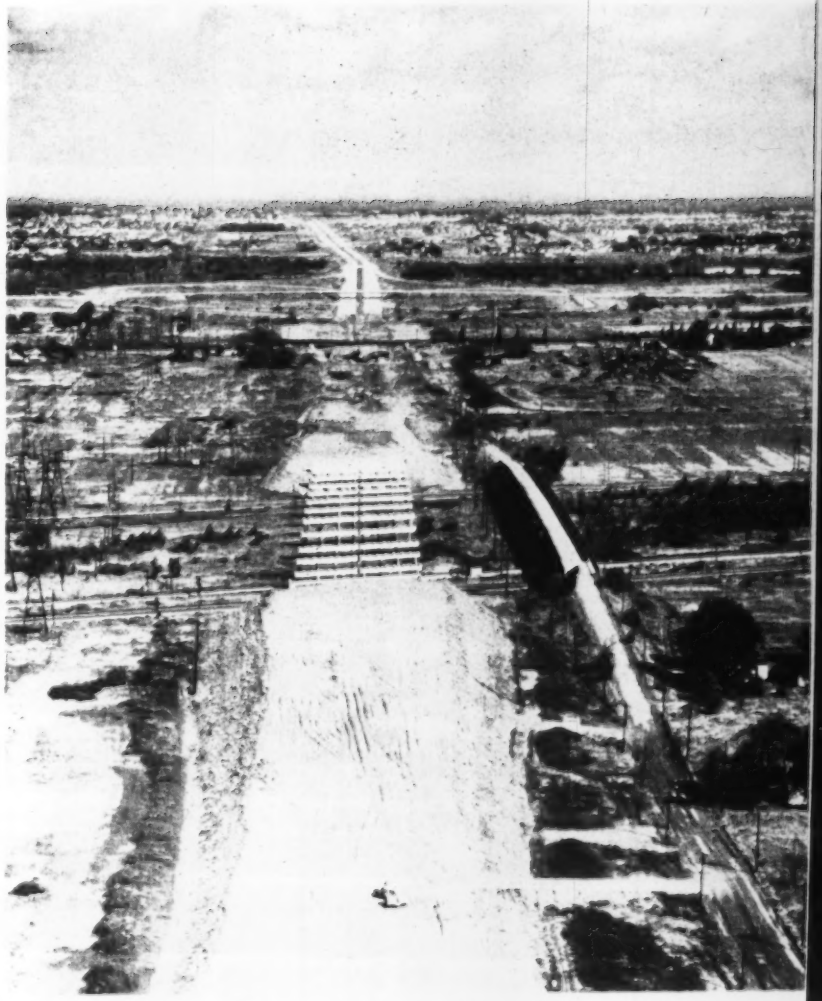
level of $35,000,000 ten years later. Toll revenues from commercial vehicles will constitute some 62 percent of the total to begin with, and will progressively increase until they reach 72 percent of the total in 1965. The importance of trucking traffic in the Thruway financial picture is evident.

One reason why passenger cars are expected to contribute only about 35 percent of the revenues, even though they constitute some 85 percent of the trips, is the extraordinary travel value offered by the annual permit. Nevertheless, the permit plays an important role in Thruway financing. It is to be available to any resident of New York State owning a passenger car. In November 1951 these residents approved a referendum placing the credit of the state behind the bonds of the Thruway Authority. This action made possible a saving of over $100,000,000 in interest charges on Thruway bonds, and the Authority feels this justifies the bargain which permit holders will get.

The state guarantee has, of course, been the principal security behind Thruway financing to date. An initial issue of $60,000,000 in guaranteed notes was sold at an interest cost of 1.1 percent early in 1952, and a total of $250,000,000 in serial bonds has been marketed this year at an average interest cost of 2.67 percent. This rate is from $^3/_4$ to 1 percent lower than that which would have been obtainable for revenue bonds marketed at the same times.

While the purchasers of guaranteed bonds look to the state guarantee for security, the state looks to the Thruway Authority and the revenues of the Thruway for protection against having to make any outlay to back up its guarantee. The economic survey has shown that the Thruway is a solvent project, and that its revenues will provide for operating and maintenance expenses and still leave enough to cover interest and amortization payments with an ample margin of safety.

Another source of revenue is that available from concessions on the Thruway. Service stations and restaurants will be provided at reasonable intervals and leased to operators on the basis of competitive bids. Several brands of gasoline will be offered at alternating stations, and the Thruway Authority will receive a gallonage royalty on sales. The restaurant operators have already been selected. There will be three different operators, one on each of three sections of the route, and payments to the Authority will be based on a percentage of gross sales. Revenues from these sources will add a considerable sum to the annual income of the Authority.



Thruway construction in Buffalo area is complex. In foreground, longest railroad grade elimination on project between New York and Buffalo (1,065 ft) carries Thruway over Lehigh Valley, Erie, and Lackawanna railroad lines.

The Thruway project has not been realized without its problems and difficulties. Actual costs have in many instances turned out to be higher than they were supposed to be on the basis of preliminary figures. Some features have had to be curtailed and others modified. But the project has gone forward within a remarkably short time because it is founded on a sound economic basis. First, it is under a separate authority with its own powers to market bonds, collect revenues and administer its affairs as an independent agency. Second, it has obtained a state guarantee of its securities, which saves many millions of dollars in interest cost and assures a ready market for its securities. And third, the project has been placed on a firm self-liquidating footing by ascertaining its revenue potential as closely as engineering methods can measure, and by establishing a system of charges adequate to pay its costs with a reasonable margin to spare.

This job of financing is still going on, but with the firm foundation that has been laid it is possible to keep a constant check on changes that may affect the economic picture and to take such steps as may be necessary to cope with them.

New York State Thruway, southeast of Rochester, has center mall 74 ft wide. In mall existing trees have been retained when at safe distance from pavement, as safety factor to reduce headlight glare, and for landscaping effect.

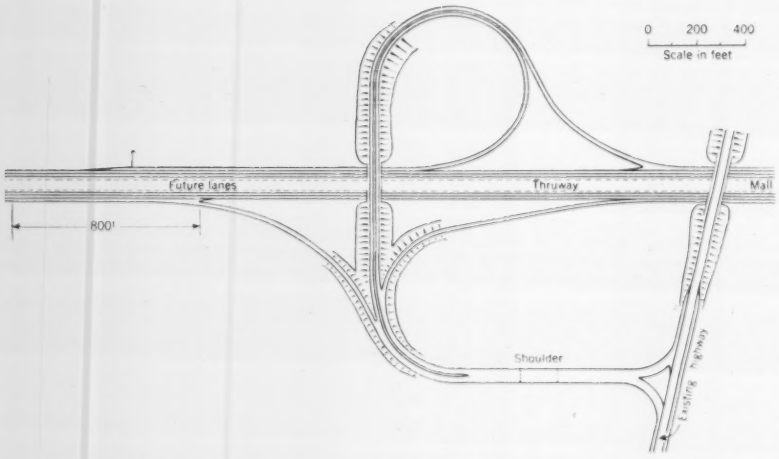
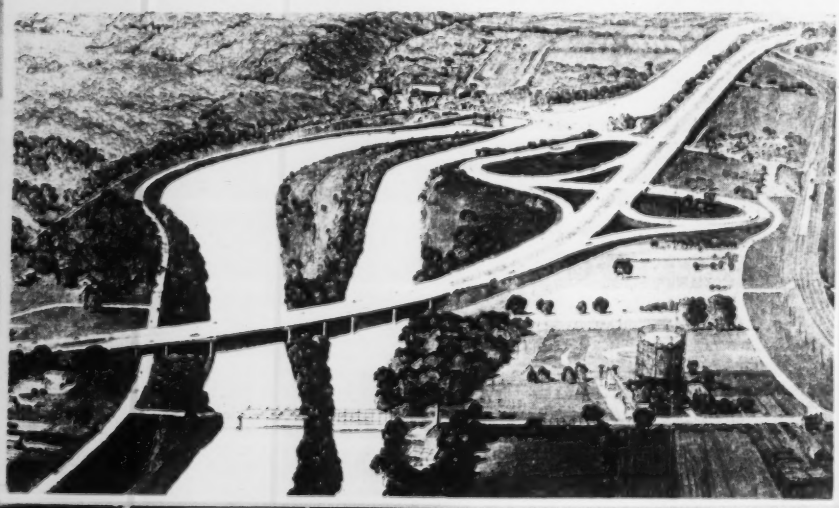


FIG. 1. One type of interchange used on Thruway illustrates aim of design to maintain sustained and uninterrupted speed, with safety.

Intricate traffic interchange is being constructed near Herkimer in Mohawk Valley to connect Route 28 with Thruway. Bridge in left foreground in this artist's drawing crosses Route 5-S, Mohawk River, and State Barge Canal.



Construction

When the design standards for the New York State Thruway were first discussed, it was indicated that our primary object was to make this route the safest, really fast highway yet constructed. To do this, all phases of the probable types of traffic had to be considered. Moreover, as far as possible, the designer had to attempt to set his design standards in anticipation of future developments by the truck and automobile industry as well as to satisfy the probable desires of the motorist. When the facility is one of the toll type, financed by long-term bonds, this becomes particularly important. The Thruway, in order to succeed, must offer the trucker and the motorist facilities so far superior to the circuitous routes over existing roads that they will gladly pay a fee for the right to use it. Sustained and uninterrupted speed, vehicular and passenger safety, freedom from delays of stopping and starting, economy of operation, and complete avoidance of congestion over its entire length are the real inducements.

For a number of years the New York State Department of Public Works made numerous preliminary studies of various so-called "superhighways" through the congested areas from New York to Albany and Albany to Buffalo. These had always been conceived as free highways. When it became apparent that to finance the Thruway with state highway funds would starve the existing state highway system out of existence, we were forced to resort to a toll system. Many of the original ideas of location as well as geometric design standards had to be abandoned. Consideration and study had to be given to a completely independent project, all on new location, instead of merely modernizing certain sections of existing highways. A great number of proposed interchange locations had to be changed, or abandoned, because they could not sustain the test of economic soundness, regardless of how desirable they

standards designed to attract traffic

J. B. McMORRAN, A.M. ASCE, Chief Engineer, New York State Department of Public Works, Albany, N.Y.

might be from a local standpoint. Location of interchanges on the Thruway was one of the most difficult problems encountered, for every community felt that it must have an interchange.

When the general location of the Thruway had been determined, it was decided that the project was to have limited access over its entire length; that all highway and railroad crossings would be separated; that traffic in opposing directions would be divided by a safety median strip, or mall; that the interchanges would be specially designed to avoid left turns and to feed traffic to and from the Thruway on the right side only (see Fig. 1); and that wide stabilized shoulders would be constructed on a wide right-of-way, without access or frontage rights.

Over its entire length the Thruway has been designed for a speed of 70 mph and upward. This does not mean that the Authority will necessarily always limit speeds to 70 mph or less. If manufacturers should determine that the public demands cars which can sustain speeds greater than at present, the Thruway is designed to handle these increased speeds. (I, personally hope that such speeds will never be permitted.) We have designed for growth in capacity as well as in speed, for should it later be found impossible to adapt the Thruway to changing conditions, the facility would soon be discarded. Obviously we cannot afford to have this happen.

Maximum grades are limited to 3 percent. This was often very difficult and costly to achieve, especially through the Catskill and Ramapo Mountain areas.

The median strip has a minimum width of 20 ft, but in many places the width is much greater. In western New York there is a long section where the widths vary between 20 and 600 ft, and in one place a very picturesque stream forms a part of the center mall through a wooded area. In certain urban sections of the New England, Westchester, and Niagara Thruways, which are on elevated viaducts, mall widths are less than 20 ft. Shoulders are 11 ft 6 in. wide with 10 ft stabilized. In certain mountainous areas the rock sections have a shoulder width of 9 ft.

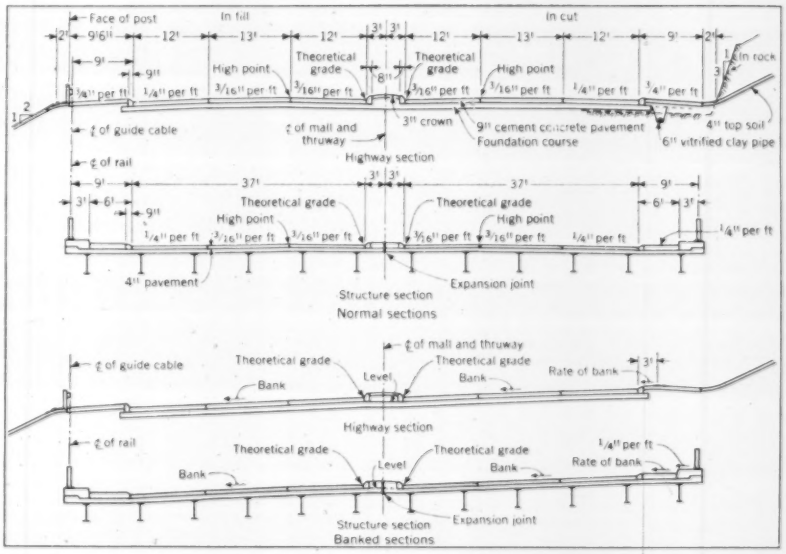


FIG. 2. Comparison of highway and structure sections for normal and banked locations shows how highway section is carried over structures without narrowing roadway.

Pavement lanes are 12 ft and 13 ft wide, making 25 ft in each direction for the two-lane sections, and 12 ft, 13 ft, 12 ft in the three-lane portions. All of the Thruway will have at least two lanes in each direction, and certain areas near New York will have three lanes in each direction. However, sufficient room has been left on structures and beneath bridges so that the entire route can be made three lanes wide in each direction, when traffic demands make this feasible (see Fig. 2).

Horizontal curves are 2 deg or less, or a minimum radius of 2,800 ft, except at interchanges. Vertical clearance for highways is 14.2 ft minimum. The minimum vertical sight distance is 1,000 ft, based on a driver's eye at 4 ft 6 in. above the pavement, looking at an object 4 ft 6 in. high. Horizontal sight distance is 1,000 ft.

Construction schedules for such a gigantic project must be practical. Our first objective is to get the Thruway built and in operation between New York and Buffalo. This will be the main support for the Erie, Niagara, Berkshire, and New England Thruways, which may not all be completely self supporting. Our target date for completion is October 1954 and all our contracts are awarded on that basis. This means, of course, that round-the-clock operations are necessary where feasible, and many of the contractors are operating on a 20-hour basis in two 10-hour shifts, with 4 hours for equipment maintenance.

Grades of less than 3 percent and curves of greater than 2,800-ft radius required heavy cuts and fills. Through the Onondaga Swamp, foundation material was stabilized by forcing water out of it through sand drains (above, left). In other locations, swampy muck was removed and replaced by backfilling with gravel. View above shows work under way in Black Lake area.

Rocky and rugged terrain along the Hudson River south of Albany, where the route traverses the Catskill and Ramapo Mountains, taxed contractors' ingenuity and the capacities of their heaviest equipment

Unusual Construction Problems

Just north of the Finger Lakes, in the center of the state, lies Montezuma Marsh. This vast area is somewhat like the bayou country of the South, and was an early barrier, both to the construction of the original Erie Canal and to that of the railroads. To construct the Barge Canal, the state acquired a large portion of this area because in raising the water level, much of it had to be flooded. The area adjacent to the Clyde River was acquired subsequently by the Federal Government as a bird sanctuary for migratory wild fowl. This bird sanctuary was found to lie exactly in the path of the New York State Thruway. Several studies were made to bypass it, but all were too costly, and after considerable negotiation between agencies of the state and Federal Government, permission was given to cross the Wild Fowl Reservation, provided however, that the water levels of the marsh would not be disturbed or the wild life molested. To solve this complex problem, about one-half mile of the Clyde River was relocated to the north, and the unstable swampy muck was removed and replaced with more satisfactory material.

North of Syracuse and at the outlet of Onondaga Lake, the Thruway crosses what was once known as Onondaga Swamp. Here the foundation material was stabilized by the use of sand drains. A layer of granular material was placed over the wet, spongy ground surface and then the entire area was covered with a heavy layer of earth. Through this earth and gravel mattress, steel tubes with closed ends were driven deep into the wet material and filled with sand. The tubes were then pulled out, the closed end being opened in the pulling process, leaving a column of sand remaining in place. As more and more weight of earth was placed over it, the water in the spongy bottom was gradually squeezed out and flowed upward through the column of sand until it met the horizontal blanket of

Work under contract, October 1, 1953

As of October 1, 1953, a total of 59.1 miles of the Thruway, a dollar volume of $38,136,675, had been completed. Work under contract, listed below, covers 353.4 miles, a dollar volume of $375,005,699.

Contractor	Mileage	Amount
Tomlinson Const. Co.	8.2	$4,133,146
Grandview Const. Corp.	16.5	5,669,412
Arcole Midwest Corp.	6.5	4,425,394
Collins Bros.	9.2	7,767,026
Lane Const. Corp.	34.8	31,530,584
D. A. Collins	0.1	1,508,975
Savin Const. Corp.	26.8	26,867,505
Louis Mayersohn	7.7	3,450,705
Arute Bros., Inc.	24.2	11,755,217
D. V. Frione & Co.	7.6	4,973,081
D. W. Winkelman, Inc.	13.4	19,475,703
A. S. Wikstrom, Inc.	6.5	8,255,021
S. J. Groves & Sons Co.	24.3	14,732,436
L. G. De Felice & Son, Inc.	14.7	19,843,070
B. Perini & Sons, Inc.	22.2	18,920,700
Baughman & Blair, Inc.	6.4	3,572,660
Potter-De Witt Corp.		3,865,648
Bero Eng. & Const. Corp.	21.5	13,076,811
W. E. O'Neill & Dann Bar		2,728,562
Johnson, Drake & Piper, Inc.	28.5	16,840,820
Depew Paving Co., Inc.	1.6	$3,736,040
Depew Paving Co., Inc. & McLain Const. Corp.	3.2	5,259,431
A. E. Ottaviano, Inc.	5.4	7,510,658
John Arborio, Inc.	19.1	12,057,022
Arborio & Corbetta	10.2	11,487,198
Walsh & Langenfelder	14.3	14,816,126
Mt. Vernon, Healey & Gammino	14.7	27,485,290
Rusciano & Son Corp.	0.9	3,884,498
Arthur A. Johnson Corp.	0.5	2,348,650
Hudson River Bridge		
Substructure:		
Merritt-Chapman & Scott		15,816,093
Construction Aggregates		6,677,533
Superstructure:		
American Bridge Co.		31,989,357

sand. Through this blanket, the moisture escaped laterally. This method was found quick, economical, and entirely successful.

Proceeding eastward across the state, the cities become closer together and the population more dense. The Mohawk River Valley generally grows more rugged and narrow as one proceeds east from the village of Herkimer.

Here again, in order to get width enough for the wide cross-section of the Thruway, it was necessary to relocate the Mohawk River by moving it to the north over a length of several miles. Fortunately this relocation improved the Barge Canal alignment, and gave sufficient width for the West Shore Railroad, Route 5-S, and the Thruway to be located south of the Mohawk in relative independence.

South of Albany the route is located generally on a bench or shelf along the west bank of the Hudson River, until it climbs up into the Catskill Mountains, near Ravena. From this point south into the Ramapo Mountains, and in fact until the Palisades are crossed to the Tappan Zee bridge over the Hudson River, the terrain is unusually rocky and rugged. It is here that the traveler on the Thruway will be given some of the most inspiring vistas and scenery, and it is through this area also that most of the real highway engineering has been required.

To keep the Thruway wholly within New York State control, it was necessary to cross the Hudson above Piermont, and we were most fortunate to find that we could come through the Palisades in a natural pass at Nyack and, on the east side, could leave the river valley through a saddle in the range of high hills on that side.

The Authority has made full use of the engineers and personnel of the State Department of Public Works. However, in order to complete the project according to schedule, it has been necessary to employ 33 prime consulting firms in the design and supervision of the New York-to-Buffalo section.

On the contractor side, the Lane Construction Company has had the greatest dollar value of contracts, $46,000,000, and also the greatest mileage, a total of 74 miles. This includes work completed as well as that now under construction.

Steel deliveries have been our greatest handicap, for the Korean War, government controls, and strikes, all of which now seem resolved, kept us on a delayed delivery basis until the middle of 1953. We will have a tremendous demand for steel, aggregates, and cement in 1954, particularly near the New York metropolitan area. The Nyack-Tarrytown Bridge will tax all the eastern fabrication shops of the American Bridge Company. Nevertheless, 1955 will see traffic speeding, safe and uninterrupted, from New York to Buffalo over the New York State Thruway, the world's longest and safest toll road.

Engineering consultants listed

Altogether 33 prime engineering consultants were engaged for surveys, design, and supervision of construction, at a total contract amount of $26,159,757.15. The firms who did, and are doing this work are the following (all of New York State):

Ammann & Whitney, New York
Andrews, Clarke & Buckley, New York
Robert W. Briggs, New Rochelle
Francis L. Brown, New York
Brown & Blauvelt, New York
John R. Campbell, Buffalo
Capitol Engineering Associates, Rochester
Clarke, Rapuano, New York
A. Stuart Collins, Buffalo
DeLeuw & Brill, New York
Duchscherer, Oberst & Wendel, Buffalo
Edwards, Kelcey & Beck, New York
Farkas & Barron, New York
Frankland & Lienhard, New York
Fretts & Senior, Williamsville
Ginnity & Morrison, Rochester
Greenhut & Taffel, New York
Frederic R. Harris, Inc., New York
Hirschthal & King, New York
Knappen, Tippetts, Abbett & McCarthy, New York
Krehbiel & Krehbiel, Kenmore
Edward J. Lupfer, Buffalo
Madigan-Hyland, Long Island City
W. H. McFarland, Binghamton
Nussbaumer, Clark & Velzy, Buffalo
James P. O'Donnell, New York
Parsons, Brinckerhoff, Hall & Macdonald, New York
Roy E. Pratt, Springville
Seelye, Stevenson & Value, New York
Charles H. Sells, New York
Senior, Bissell & Bronkie, Williamsville
D. B. Steinman, New York
Urquhart & Doyle, Scarsdale

NEW YORK STATE THRUWAY

CONRAD H. LANG, M. ASCE

Deputy Chief Engineer, New York State Thruway Authority, Albany, N.Y.

Concrete pavement 9 in. thick supported by 4 ft of selected material

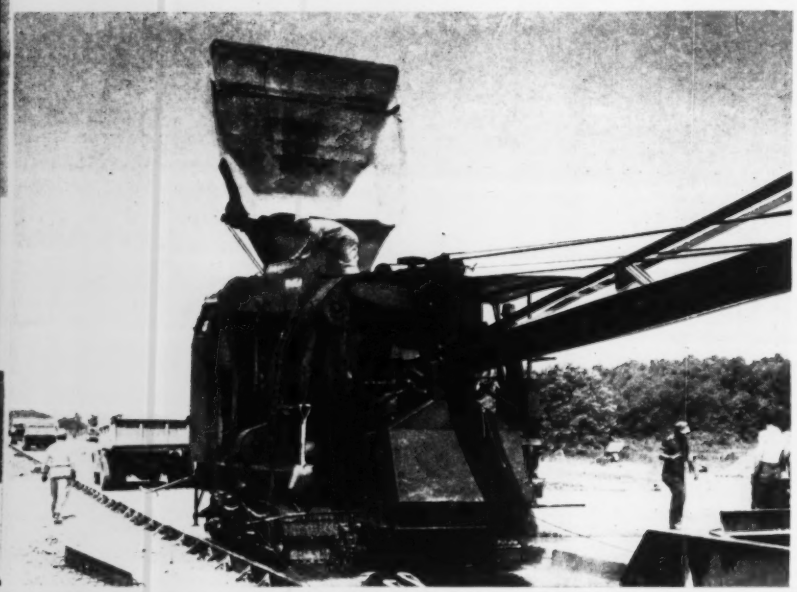
Engineering work in connection with the construction of the Thruway is performed on behalf of the Thruway Authority by the Superintendent of the State Department of Public Works and his subordinates, according to the terms of the legislation which created the Thruway Authority on March 21, 1950. The Authority is fortunate in having the Department supply these engineering services, for in this way hundreds of experienced highway and bridge engineers are placed at its disposal to design or supervise the design of the entire system. In the matter of the pavement alone, we are thus able to base our design on the wealth of experience and judgment acquired by these skilled engineers over a period of more than 25 years during which the Department has constructed over 13,000 miles of highways.

The thinking which preceded the planning and construction of the Thruway pavement therefore can be said to have originated in the State Department of Public Works and it is to the Department's specifications that we are now building the system which, when complete, will extend for over 500 miles through the Empire State. The basic requirements of our specifications for the construction and preparation of the base course and subgrade, and for the concrete pavement, follow.

No discussion of a highway pavement would be complete without mention of the most important element in the design, namely, the foundation. Our concrete pavement depends for its integrity solely on three engineering materials—steel, concrete, and the soils of the foundation. Of these three, steel is the newest product evolved by man and the one whose behavior can be most accurately predicted. Paradoxically, it is the least important to the ultimate behavior and service record of the pavement. It is used as mesh reinforcement for the purpose of distributing cracks in the concrete and for holding those cracks together. It is also used to support the transverse and longitudinal joints.

Concrete is an older product, and while great strides have been made in late years in improving its quality, we still cannot predict its behavior with the degree of exactitude we can that of steel. Yet the importance of achieving the finest quality of concrete cannot be overemphasized if we are to produce a riding surface for the traveling public free from the surface scaling, disintegration, and excessive cracking that concrete may be heir to.

Soils are our oldest construction material and the most complex and least understood. In order to insure a smooth riding pavement, free from unequal settlement or localized settlement at the joints, it is essential that the supporting subgrade be as uniform as possible. The highest quality of concrete is useless as a pavement if the foundation soils are inadequate for its support. Furthermore, no joint support of whatever design will continue to function as intended if the subgrade material at the joint is subject to removal by pumping or other causes.



Self-propelled mixer places 9-in. concrete pavement on prepared subgrade.

Subgrade 4 Ft Deep

In general, the factors affecting uniformity of support are the characteristics and methods of placement of the foundation and base courses, variations in soil type, variations in moisture content, and changes within the soil structure caused by frost action. The greater part of the Thruway system is in an area where frost is a consideration of major importance.

We have attempted to provide uniformity of material for a depth of 4 ft below the pavement. To achieve this, care is taken to roll embankments to a dry density of at least 95 percent of the maximum dry-weight density as determined by the AASHO standard test. In cuts, the standard procedure calls for shaping and rolling to obtain the same uniform density. Where major non-uniformity of soil conditions exists in cuts, and especially where frost-susceptible materials are encountered, the materials are removed and backfilled as required to obtain subgrade uniformity. At transitions between cut and fill a wedge section is used both longitudinally and transversely so as to provide a gradual change from embankment to cut over a distance of 40 ft.

Thruway cross sections are planned so that the subgrade will give uniform support, with particular emphasis on uniformity of moisture content. To obtain the desired results, our design provides that the grade of the pavement shall be a minimum of 4 ft above the existing ground level, the ditch invert, or the intercepting underdrain. Exceptions to this rule occur where soil and rock conditions are uniform, and where ground water and subsurface seepage present no problems. These criteria apply to both cut and fill conditions.

Base Course Rolled in Two 6-In. Layers

The State of New York is in a glaciated area where glacial gravel deposits occur in abundance. These deposits represent the most economical granular material available for subgrade construction; consequently their use is most desirable. Having in mind the character of the available gravel deposits and the wide experience of the Department of Public Works in the use of such materials over a period of many years, it was decided that the standard Thruway section should provide a base course of granular material 12 in. thick. This thickness is modified,

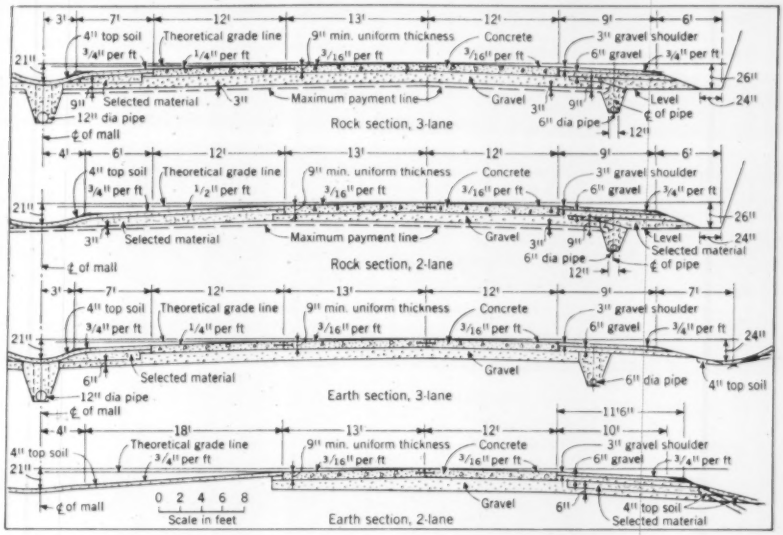
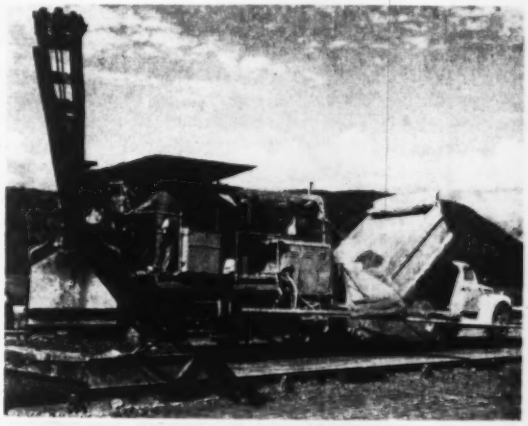


FIG. 1. Comparison of two-lane and three-lane sections in rock and in earth shows ease with which entire Thruway length can be converted to three-lane width when traffic demands makes this feasible.



Paving mixers, from 27 E to 34 E size, operate on subgrade, placing concrete in 12-in. and 13-ft lanes with transverse joints 100 ft apart.

Final finish is by hand, after which surface is roughed longitudinally with a burlap drag.

Reinforcing bar mats, usually welded wire mesh, are placed 2½ in. below pavement surface. Mechanical screeds finish surface both longitudinally and transversely.

Wide central mall divides the roadways.

as required by the character of the soil, frost conditions, and general terrain.

The specifications provide that material in the base course must meet the following gradation requirements: 100 percent must pass the 4-in. sieve; no more than 50 percent must pass the $^1/_4$-in. sieve; and no more than 10 percent must pass the No. 200 sieve. In addition, the stone must be of a durable quality and the material must be satisfactorily graded from coarse to fine. Two 6-in. layers of this material are placed and thoroughly rolled. In numerous instances, where the availability of material meeting the specification is limited, the lower half of the base course is constructed of less suitable granular material, and only the top 6 in. is constructed to the specification gradation and qualities noted above. In general, the gradation of both the subbase and the base-course materials is such as to prevent infiltration, and to preclude the migration or ejection of material at the sides of the pavement or through the joints.

Concrete Pavement 9 In. Thick

With regard to the Thruway pavement, it is a basic concept in the design of all the concrete pavement that the slab must carry the wheel loads and distribute them to the foundation below. Presuming a perfect foundation, it would be possible to construct a pavement suitable for heavy Thruway traffic with a thickness of perhaps only 4 in. (As a matter of fact, some of the Thruway bridges are constructed with separate wearing surfaces as thin as 3 in.—made possible by the uniform support given the pavement by the bridge deck.) If our pavement foundations could be constructed to perfect uniformity, we could save a considerable portion of the funds which we are now expending for a concrete pavement 9 in. thick.

Actually, in spite of the care and precautions taken by our soils engineers, it is not economically possible to achieve in the field these desirable results. Consequently the Thruway pavement had to be designed strong enough to span the areas of low resistance to deflection in the subgrade as constructed. In this respect the pavement acts like the continuous concrete spans in a bridge, the overall length of which extends from New York to Buffalo.

The pavement itself is constructed with a 1 : 1 $^3/_4$: 3 $^1/_2$ mix, by volume, converted to weight batching in accordance with the specific gravities of the aggregates. Voids in the coarse aggregates are assumed to be 45 percent, and those in the fine aggregates 35 percent, with a 3-percent moisture content in the latter. Field adjustments are made up to 10 percent plus or minus in the fine aggregate, with opposite weight adjustment of the coarse material.

Cement permitted by the specifications is either a portland cement with an air-entraining agent or a mixture of portland and natural cements in the proportions of 7 parts portland to 1 of natural. Practically all our Thruway pavement is constructed of air-entraining concrete.

Fine and coarse aggregates must meet rigid specifications. Crushed stone is preferred although crushed gravel and crushed slag of suitable characteristics are permitted for coarse aggregate.

Water content is controlled by the civil engineer in the field so as to obtain the driest mix consistent with workability. Usually a 2$^1/_2$- to 3-in. slump is considered satisfactory. Test cores cut from this pavement show compressive strengths of from 4,000 to 6,000 psi depending on the age of the concrete when the cores are tested.

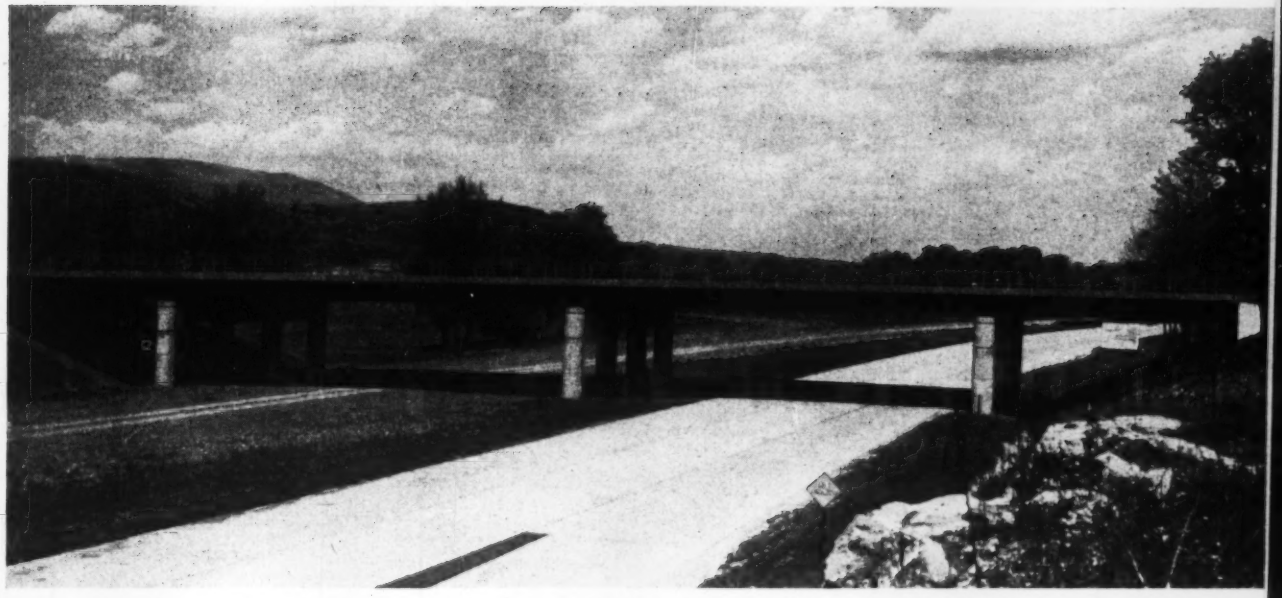
Concrete is mixed in the usual type of paving mixer, not smaller than the 27E and not larger than the 34E, single or two-compartment machines. Recently permission has been granted to use transit- and central-mixed concrete under rigidly controlled requirements.

The concrete is laid in lanes either 12 or 13 ft wide, and in slabs 100 ft long. Transverse joints at this spacing are of wood or fiber with joint supports of various types. The latest approved type is dowels of 1 $^1/_4$-in. diameter spaced 12 in. on centers. Longitudinal joints are of the tongue-and-groove type, doweled together by bolts and sleeves at 5-ft centers. Near the ends of the slabs this spacing is reduced in stages to a final spacing of approximately 12 in.

Reinforcing-bar mats are placed in the pavement at a depth of about 2$^1/_2$ in. below the pavement surface. Intermediate bar mats are either of welded wire or clipped deformed types and weigh about 65 lb per 100 sq ft. End mats 8 ft long and weighing about 130 lb per 100 sq ft are used adjacent to transverse joints to provide additional reinforcement at these critical points.

The pavement surface is finished by both transverse and longitudinal screeding, after which the usual hand methods are used. The final operation consists of roughening the surface with a longitudinal burlap drag. The pavement is then immediately covered with quilts or waterproof paper blankets and cured for a period of at least ten days before it is opened to traffic. Immediately upon removal of the quilts or blankets, the pavement is given two applications of petroleum distillate oil at the rate of 1 gal per 17 sq yd for each application. The purpose of this treatment is to minimize the surface deterioration which is apt to occur when salts are applied for winter snow and ice control.

The foregoing description applies to the pavement design for the Thruway proper and for most of the earlier interchanges and cross roads. Recently, we have evolved a design for plain concrete pavement which is being constructed without reinforcement and without transverse joint supports except on interchanges and access roads. In this design, contraction joints are placed at intervals of 20 ft by grooving the pavement transversely to a depth of 2$^1/_4$ in. This construction continues until the end of the day's pour, at which point provision is made for a doweled joint. Supports in the form of dowels are also used for several of the transverse joints immediately contiguous to bridges or to pavement of the conventional design.



New York State Thruway structures have real esthetic value and give motorist good view in all directions. Typical use of column pier bents for structures carrying highway over Thruway is illustrated.

Bridge design is guided by esthetics as well as functional considerations

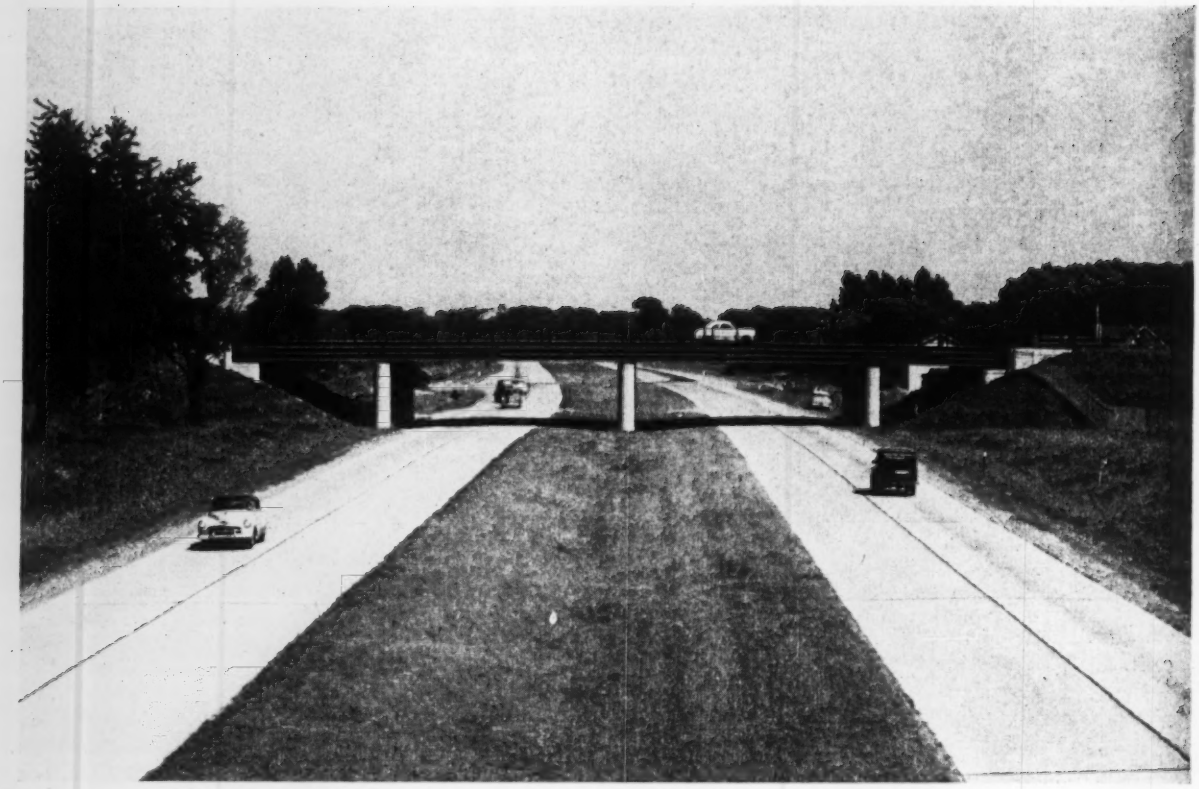
E. W. WENDELL, M. ASCE, Deputy Chief Engineer, New York State Department of Public Works, Albany, N.Y.

When we recognize that there are 552 bridges on the 500-mile Thruway, it is evident that time was an important factor in the problem of design. We had to be careful lest the desire for mass production and speed should dominate the problem. It obviously was highly desirable—yes, necessary—to recognize that time had top priority, and yet we refused to believe that a bridge which would be truly a functional expression of this great artery could not be produced. It must not be overlooked that we were in no sense starting from scratch. In my office we had been designing and constructing a bridge every working day for more than twenty years. When I say bridge, I refer to a structure of more than 20-ft span, which carries a highway over a stream, a canal, another highway, a city street, a parkway or a railroad, or in many instances which carries a railroad over a highway. These structures have been of various types and dimensions, from a structure designed to carry a two-lane highway over a small stream to the complete elevation of a two-track main-line operating railroad through an entire community.

We have recognized certain basic principles in our design. We advance no claim for their origination. We have endeavored to differentiate between the application of landscape architecture, where the functional flow is the creation of space, and the functional flow of a highway, which is simply the continuation of a highway through space.

We do not consider that mass is an essential requirement of beauty. In many instances, the viewpoint seems to prevail that the form of a bridge must be based upon its ability to carry the weight of a stone facing or some other exterior adornment. We have taken the attitude that the environment and purpose of a bridge create the basis for functional design.

We have been fully cognizant of the oft-repeated statement that engineers are as devoid of esthetic reactions as are the compilers of shop drawings for the fabrication of steel. Fortunately this lack does not pervade the entire profession, and indeed we consider it unfortunate that



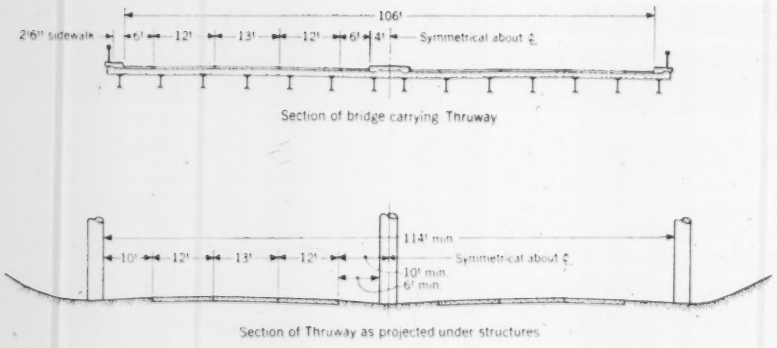


FIG. 1. Full section of Thruway is carried over and under structures.

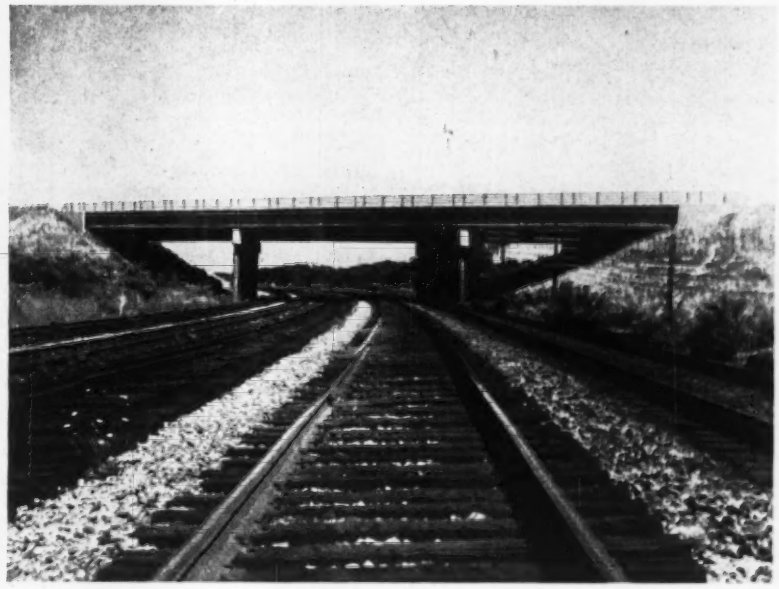
architecture, developed outside our profession, has in many instances descended to mere decoration when applied to bridges. For example, massiveness in railings is purely decorative and not functional.

Our completed structures clearly indicate that lightness is more agreeable in horizontal members than in vertical members. Placing a heavy rail or coping on a bridge either by the use of stone or by the use of solid or heavy members destroys the very effect that is sought, and which is ever pleasing to the eye of the observer. To cover the clean vertical lines of piers or abutments, or any other portion of a substructure, by veneer or decoration in such manner that the functional appearance is buried, seems to create a drooping effect. This results in a structure that appears to be struggling to hold itself up, in place of one that enjoys the exhilaration of live loads.

In approaching the problem it was fundamental that some concept be had of a type of structure that would accommodate traffic without restriction, both over the deck and beneath it. In addition, it was recognized as an essential that unrestricted vision be obtained in structures of this type. It was considered that whenever the Thruway passes over a stream, a railroad, or adjacent highway or street, the section of the highway should be projected onto the bridge without presenting any real or mental hazard to drivers. It was further considered necessary that when the Thruway is projected under a structure carrying any other facility, no physical or mental hazard be created in the movement of traffic. In all instances this means that there cannot be any narrowing of the pavement or restriction of side clearances when the Thruway passes under a structure, and that under no circumstances should the shoulder section be narrowed when the Thru-

Structure spanning Thruway incorporates use of steel fascias. Light type of railing gives motorist good visibility.

In typical structure carrying Thruway over a main-line railroad, side view is considered unimportant, making economy governing consideration. Thruway section itself is such that motorist is unaware he is passing over a railroad or another highway. See Fig. 1.



way is carried onto a structure over any other facility. In other words, the basic consideration is the esthetic relationship between the free moving, open Thruway and the components of the structure created to maintain this free and unobstructed movement. In no instance would we accede to a through structure of any type if we could possibly avoid it.

Continued study led to the conclusion that, with variations in expression, the most flexible type of structure was a four-span beam bridge. This resolves itself into an economical and yet withal a pleasing structure to the user of the Thruway. We opened up the center pier. We developed stub abutments at the top of the side slopes which permitted us to establish a pleasing type of open pier or column bent adjacent to the edge of the outside lanes. With a proper clearance, this design gives a complete, open movement to traffic.

The design not only creates an even diffusion of light under structures that are extremely wide, where the Thruway is carried over another facility, but in addition it dampens the roar of a car in the enclosed area under the bridge. Instead of echoing the sound waves, the columns break them up so that the reaction is not unpleasant to the ear of the driver. This feature must be recognized and carefully analyzed, to ensure that, at wide structures, where a major traffic artery passes over or under the Thruway, the reaction to the user of the highway is one of pleasure rather than one of annoyance.

A concerted effort was made in planning the Thruway so that for the most part it would be carried over rather than under intersecting railroad rights-of-way. Whenever this could be done it eliminated entirely the necessity of supporting an operating railroad during the construction period. In the design of structures to carry tracks over a highway, it has been found that from 25 to 40 percent of the cost of the finished structure may be spent in supporting the railroad while the substructures to carry the railroad over the highway are being constructed. It has been found in the field that the development of the type of structure which we have advanced for carrying the Thruway over a railroad creates no serious obstruction to the operation of the railroad or to the construction of the bridge—a decided economic advantage, enabling a large proportion of the expenditures for these structures to be used at other places along the Thruway. There are locations where it is impossible, because of topographical conditions or built-up urban or semi-urban developments, to carry the Thruway over a railroad. In such instances we have negotiated with the railroad company and were able to obtain its cooperation in minimizing the number of tracks left in service during construction. This practice led to a reduced cost for this type of structure when one had to be built.

In arriving at the width of a structure necessary to take care of intersecting highways, streets or parkways, full consideration is given not only to present needs as shown by traffic studies, but also to the needs that will develop in the next 20 years. In anticipating future needs, attention is given to the probable development of the locality together with its effect on traffic on the highway or street which is intersected. In addition to the width of pavement necessary to carry the traffic, these structures provide a wide clearance from the edge of through traffic lanes to the curb, in conformity with the standards we have established for state and local highways. In planning these structures which cross over the Thruway, consideration is given to the esthetics of the environmental relationship as well as to the functional ability to accommodate traffic movements both on the cross route and on the Thruway.

The typical cross-section carrying the Thruway under a structure is shown in Fig. 1. The 114-ft width between shoulder columns will of course vary, depending on whether it is necessary to carry an acceleration or deceleration lane under the structure.

Since the center mall is depressed and receives drainage from the pavement surface, it can easily be seen that considerable care must be taken in the development of the design so that the finished structure, including the center pier, will fit properly into the Thruway and in no way interfere with the drainage of the pavement surface. In general, the drainage is taken from the center mall adjacent to the pier face on the up side of the grade and carried to the sides of the road or, where this is not practicable, it is carried under the

This bridge illustrates type of structure used to carry Thruway over New York State Barge Canal.

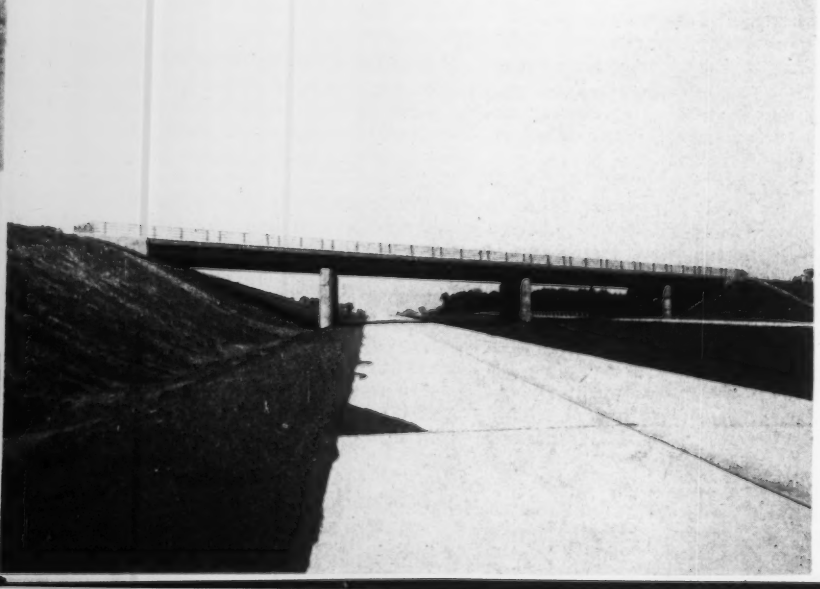
mall section adjacent to the center pier on one or both sides of the pier, depending upon the volume of water expected.

The typical cross-section of a structure carrying the Thruway over another facility is also shown in Fig. 1. Here again it is to be noted that care must be exercised in the design to develop the depressed mall into a proper introduction to the bridge head so as to produce a pleasing appearance and yet properly take care of drainage. Since curbs are not used on the Thruway, special attention is directed to the treatment of the mall width across the end of the bridge in order to produce a satisfactory, usable structure as well as one having a good appearance.

The design loading used on all bridges carrying the Thruway is a H2O-S16 truck train. The train consists of a series of H2O-S16 vehicles spaced 30 ft from the rear axle of the preceding vehicle to the front axle of the following vehicle. This we feel sure provides adequately for the foreseeable future. Structural steel is recognized at 18,000 psi; concrete at 1,000 psi.

Railings, while of the distinctive type which we have developed and used for several years, are designed of the same strength as the so-called barrier-type railing. Why a railing should be used which detracts from the esthetics of a structure simply because it looks stronger is rather difficult for us to understand.

Bridge carrying highway over Thruway is typical of structures used at skewed crossings.



In all applicable instances we design for composite action in the bridge slab. In some instances we use continuous structures, or structures involving suspended spans with cantilever and anchor spans, but in general we utilize simple spans. Our use of open-ended tubes from 18 to 30 in. in diameter, driven to rock, as the principal element in our column bent design, has resulted in savings of millions of dollars.

It is the careful analysis of all subsurface information, with our background of more than 25 years of experience in foundation design, covering many thousands of bridges, that has produced the economical foundation designs used throughout for the substructures of the bridges. Simplicity of construction is the keynote in all our designs, whether in superstructures or substructures. This does not mean that we have not been confronted with a wide variety of subsurface conditions from New York City to Buffalo. Quite the contrary. It does mean that we have been designing bridge foundations successfully over this area for more than a quarter of a century. In the last half dozen years we have been able to obtain subsurface information more quickly and more uniformly because of the development of an enlarged Soils Bureau.

We have found that there is no substitute for experience in the design of the foundations for our bridges. This in our judgment is one portion of the design of a bridge which cannot be solved by specifications and computations. It can never be properly established by a set of standards. These matters I cover because, over the past forty years, our profession has swung from the "let-the-men-in-the-field-decide" attitude to the "let-the-soils-men-decide" attitude. Neither of these attitudes can ever be substituted for a background of experience in the design of foundations for bridges. Soils information is essential, as is proper supervision in the field to detect any variation from the basis of the design. It is true, however, that neither of these constitutes a substitute for an understanding analysis of foundation design.

It has been pleasant to associate with the men in private practice who, with their organizations, have made it possible for us to prepare the contract plans for this volume of construction. With many of these engineers we had been previously associated. To them and to those with whom we have been associated for the first time, we extend our appreciation.

ONTARIO

HYDRO TUNNELS

JESSE R. GLAESER

Vice President and Chief Engineer

B. Perini and Sons, Inc.

Framingham, Mass.

Lining concrete pumped into place

In an article in the October *Civil Engineering*, Mr. Glaeser described the equipment and procedures adapted by the contractors for excavating 2½ million cu yd from the notably large twin power tunnels around Niagara Falls, for the Sir Adam Beck–Niagara Generating Station No. 2 of the Hydro-Electric Power Commission of Ontario. Here he explains the unusual machines and methods, some of them unique, used to place more than 600,000 cu yd in the concrete lining in the tunnels to a finished diameter of 45 ft, and to grout the surrounding rock.

Concrete requirements for the Niagara power tunnels, excavated in rock to 51-ft diameter 250 ft below the surface, with horizontal and vertical curves and 30-deg slopes at the ends, present several unusual construction problems. Under the terms of the contract with the Hydro-Electric Power Commission of Ontario, the contractors are supplied with concrete delivered into their trucks at their two mixing plants. One of these mixing plants, known as the Whirlpool plant, is located at the outlet end of the tunnels, and the other, known as the Chippewa plant, is located near the intake works. The two plants are similar in design and capacity, and each will produce 200 cu yd of concrete per hour. Each consists of four 2-cu yd Smith mixers and a fully automatic Johnson mixing plant. They have a combined storage capacity of 16,000 bbl of cement and 1,200,000 tons of aggregate. The concrete moves out from the mixers on overhead conveyors discharging from down-spouts for truck loading.

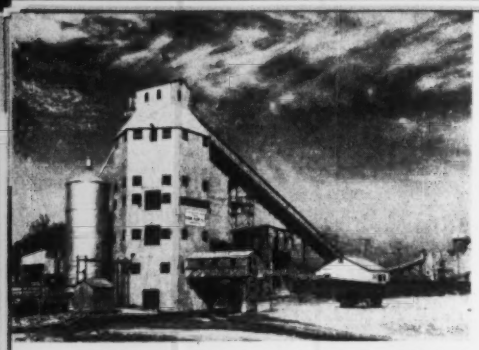
Sand for the most part is shipped in by gondola cars from the nearest suitable source 100 miles away, and is unloaded onto a 30-in. conveyor for stock piling. A small quantity of sand is dredged from the Niagara River and delivered to the plant by truck.

Coarse aggregate is produced from the limestone rock found in the upper layers of the canal excavation on the project, and is processed by one of the most modern crushing and screening plants ever erected in Canada. It is located near the area of the outlet canal excavation.

Primary crushers are two 42 × 48-in. Traylor crushers fed by two Stephens-Adamson giant feeders 5 ft wide. These giant feeders are operated on a Ward Leonard electric control system, which gives variable speed control for regulating the feed of the rock to the crushers. The primary crushers are set to crush to $4^1/_2$ in.

The crushed material is carried on a 36-in. belt conveyor to four 5 × 10-ft standard double-deck Dillon scalping screens. Oversize material is fed into two $4^1/_4$-ft Symons cone crushers, and then all crushed material is conveyed on a 30-in. belt to six classifier screens, and finally is stockpiled for use.

Since most of the concrete on this development is being placed by Pumperete machines, the largest size of rock is limited to $1^1/_2$ in. There are only two sizes of coarse aggregate



Concrete is delivered by Hydro-Electric Power Commission into trucks of contractors at their two mixing plants, which are similar in design and capacity—200 cu yd per hour. In plant No. 1 here shown, cement silo is at left and aggregate stockpile at right.

Concrete mix

Tunnel arch

(Standard 7-bag mix per cu yd)

Cement	612 lb
Water	348 lb
Sand	1,300 lb
Stone	1,880 lb
Water cement ratio	5.7
Slump	4½–5½ in.
Mixing time	1¾ min
Av. compressive strength, 28 day	4,600 psi

Invert

(6 bags per cu yd)

Cement	525 lb
Water	305 lb
Sand	1,340 lb
Stone	1,940 lb
Water cement ratio	5.8
Slump	2½–3 in.
Av. compressive strength, 28 day	4,400 psi

Grout mix

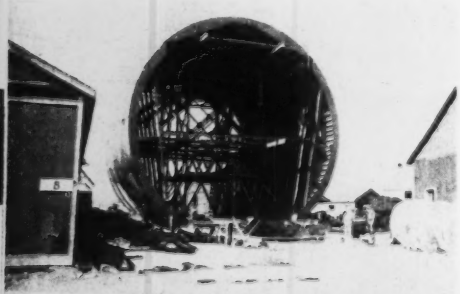
Low-pressure grout (1 cu yd)

Water	746 lb
Cement	785 lb
Fly ash	260 lb
Sand	1,523 lb
Flow cone	13.2 sec

High-pressure grout (two of many mixes, proportion only, a few cu yd)

Mix A	
Cement	175 lb
Water	120 lb
Fly ash	43.75 lb
Water cement ratio	6.9
Mix B	
Cement	87.5 lb
Water	131.25 lb
Water cement ratio	1.5
Thinned underground to 2.0	

Concrete tunnel lining is poured in three stages—curb, invert, and arch. Arch form, for 300 deg of 45-ft-diameter circle, is here seen erected on surface preparatory to being disassembled, taken down shaft in lift, and set up in tunnel.



used, 1½ and ¾ in. The aggregate for the Chippewa plant is hauled by trucks from this crushing plant, a distance of 6 miles.

Concrete lining for the tunnels is poured in three stages—the curb, the invert, and the arch. The curb is poured directly following the bench rock excavation and serves as a roadbed for the movable-form travelers and equipment used for the invert and arch concrete pours that follow.

The curb concrete is poured into portable steel form panels set to line and grade by the contractors' civil engineers. These forms are set on each side of the tunnel center-line 24 ft apart, with their tops 18 in. below, and outside of, the 45-ft finished diameter of the concrete lining. This concrete curb later forms part of the required 3-ft thickness of the lining but is not an exposed part of the finished lining. After the forms are set, the concrete for the curb is hauled in Dumperete trucks from the batching plant to the nearest shaft, where the trucks are lowered on the cage to the tunnel level and dump their loads directly into the forms (Fig. 1).

Invert concrete forms the 60-deg bottom segment of the 45-ft-diameter circular lining. The method of pouring the invert is rather unique. The concrete is hauled in semi-trailers equipped with 10-cu yd dump bodies from the batch plant to previously driven churn-drill holes 12 in. in diameter. These holes, which extend from the ground surface to the tunnel level, are located about at 500-ft intervals along the tunnel. (See Fig. 2.) They were drilled on the tunnel center-line and lined with a 10-in. steel casing ⅜ in. thick. The steel casing was welded at the joints as it was lowered into the churn-drill hole, and the small space between the casing and the rock was grouted to prevent water leakage into the tunnel and also to form a smooth backing in the event the concrete wears through the steel casing.

At the bottom end of the casing, a steel boot is suspended from the tunnel roof supports. This boot is 24 in. in diameter and 6 ft long, with a 24-in. side discharge connection. The bottom end of the boot is capped with a heavy steel plate and filled with drill steel and concrete to take the shock of the wet concrete as it drops from the surface.

Directly under the boot is located a 15-cu yd hopper and swivel chute mounted on a steel tower. The tower is mounted on wheels running on 80-lb rails along the curb so that it can be conveniently moved from hole to hole. When in pouring position, the steel tower just clears the bottom of the boot and supports it by being wedged tightly to it before each pour. The boot at each hole is set ahead of the concrete operation and lifted into position from the tunnel bottom by a truck-crane cable threaded down the hole from the surface.

The next step in the preparations for pouring the invert was to provide a unit for transporting the concrete from the down-hole to the screed. This unit is self-propelled by a 200-hp diesel engine mounted on a steel-frame traveler, with steel wheels riding on rails along the curb. It is geared to travel about 4 mph and is provided with a MGH-220 marine-gear twin-disk hydraulic coupling so that the operator cannot shear stud bolts or break the drive shaft by quick starting.

This concrete-carrying unit has three 10-cu yd cylindrical hoppers and so can carry 30 cu yd each trip. At the bottom the hoppers are cone shaped, with jaw gates and swivel chutes attached for placing the concrete. As a safety measure the operator has two control positions to use when traveling, one looking in each direction. The unit has mechanical brakes working on drums attached to each wheel, and air brakes attached to a differential drive.

The concrete is dumped just ahead of a steel screed 10 ft long and 24 ft wide, which rides on the top edge of the steel panels set on the inside face of the curb. This screed, which is weighted down as required to keep it from floating, is hauled along by a car puller anchored to the rock in the center of the tunnel several hundred feet ahead of the pouring area. The screed is made of steel plate attached to bridge framing, curved to fit the bottom 60-deg portion of the 45-ft circular tunnel diameter. As this screed is dragged along over the fresh concrete, the true shape of the invert is formed.

Following the screed, a crew of finishers works from a movable bridge that also travels on the steel-form panels, clearing the finished concrete by 2 in. The finishers give it a steel-trowel finish and place Richmond screw anchors near the top edge of the pour for anchoring down the arch form. The finished invert is finally covered with a waterproof paper for protection and proper curing.

Pouring of the invert is usually carried on for two eight-hour shifts per day, and in that time 500 ft is poured. This takes between 1,600 and 1,800 cu yd of concrete, depending on the amount of overbreak.

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The third 8-hour shift is devoted to moving form panels and rails ahead, where they are reset for the next day's pour. This allows 8 hours of curing time, but inasmuch as the fresh concrete poured on the second shift lies in between, a movable traveler leap-frogs the form panels over this area. There is also another form-traveler ahead of the concrete carrier. These two travelers are powered with 145-hp Ford V8 engines.

All mobile travelers are the same height and are provided with roller conveyors along each side to match, so that the form panels and rails can be rolled ahead from the rear carrier, across the concrete traveler, to the front carrier in a few minutes. These form carriers have small derricks mounted at each corner to pick up the panels and rails and to lower them into resetting position. In this manner 500 ft of invert is poured smoothly each day with clockwork precision, and is hardly noticeable in the midst of all the other work going on in the tunnel.

All the equipment used in invert pouring was designed, fabricated and erected on the job by the contractors' engineers, mechanics, and steel workers. This equipment was first erected above ground and then taken apart, lowered into the tunnel on the cage, and reassembled. It has been taken down and reassembled several times in moving from one section of the tunnel to another, and from tunnel No. 1 to tunnel No. 2.

In pouring this amount of concrete, six 10-cu yd trucks are usually kept busy hauling concrete from the plant to the down-hole. At the down-hole, the concrete is dumped from the truck into a 13-cu yd worm-fed steel hopper which feeds the concrete down the hole as required. The diesel motor used for operating the worm, the hopper, the signal lights, and the telephone is moved from hole to hole in a few hours between pours. Telephone and light signal wires are run down an adjacent hole.

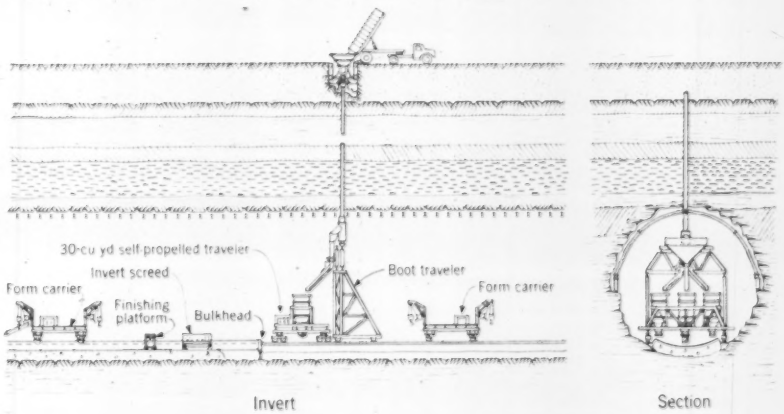
The arch pour constitutes the remaining 300 deg of the 45-ft-diameter circle. The steel forms for this work are taken down the shaft in the largest sections possible and erected on rails to 16-ft gage on 12 × 12-in. timber cross-ties supported on the finished invert concrete. Three 10 × 16-ft steel travelers erected on this track are equally spaced to carry the steel arch-form panels. Fourteen 5 × 30-ft top panels are bolted together to make one continuous form 70 ft long. The top panels rest on 12-in. double-channel jacking beams for moving up and down. Hinged to each side of these top panels are 14 side panels 35 ft long to complete the 300-deg arc. When in pouring position, the lower ends of the side panels are anchored to the Richmond screw anchors previously set in the invert.

When the form is to be moved, the side panels are swung in with steamboat ratchet jacks attached to the legs of the travelers, and the top is lowered about 3 in. for clearance by means of twelve 50-ton hydraulic jacks. This form weighs about 300 tons, with spreader beams, hoppers, chutes, and working platforms. Attached to the front end of the form is a steel bulkhead to which wooden lagging plank is fastened and adjusted to fit the contour of the rock.

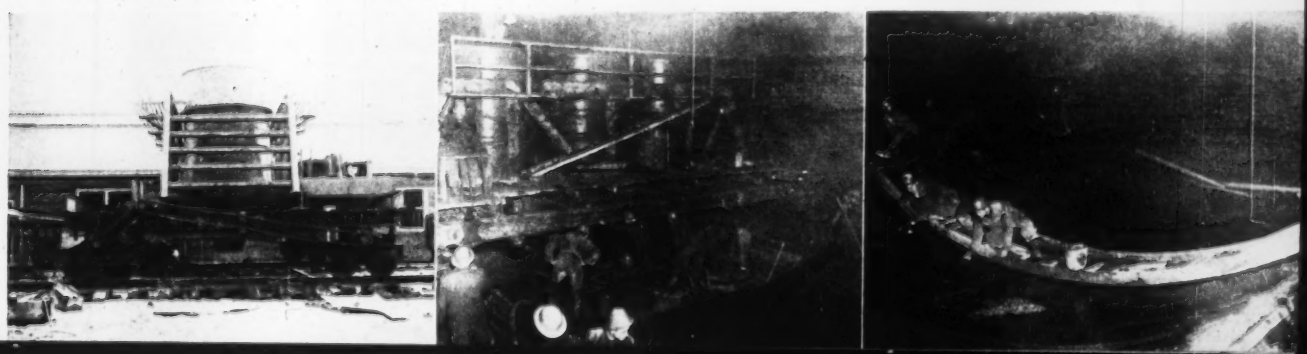
Concrete for the arch is delivered from the mixing plant to the tunnel

FIG. 1. Curb is poured first, directly from Dumpcrete trucks lowered down shaft in cage. Curb forms roadbed for form travelers and other equipment used for pouring invert and arch.

FIG. 2. Concrete for invert is dropped through steel-cased holes to tunnel level, where it is received in hopper mounted on wheeled tower. Thence it is fed into three 10-cu yd hoppers mounted on self-propelled steel-frame traveler which transports it to site.



Invert is poured from car (left) which runs on rails along previously placed curb. Car carries three 10-cu yd cylindrical hoppers. When these have been filled with concrete dumped through down-hole, car is self-propelled by 200-hp diesel engine to point of placement (center). Here concrete is dumped just ahead of steel screed riding on steel panels set on inside face of curb. Next comes crew of finishers working from movable bridge (right) which also travels on steel-form panels and clears finished concrete by 2 in.



in the same manner as that for the invert (Fig. 3). At the boot discharge at the bottom of the down-hole, a steel tower supports a 15-cu yd hopper and a three-way swivel chute discharging concrete into three Model 200 double Rex pumpcrete machines. These three machines are mounted at the base of the tower. The hopper over each pump holds 10 cu yd of concrete. A working platform surrounds the pumps to carry transformers, tool boxes, and extra working parts. The tower, hopper, and pumps are mounted on wheels and ride the curb rails when moving from hole to hole. On the rear end of this traveler is mounted a $22^1/_2$-ton winch, geared down to pull 200 tons, for towing the rig.

Three 8-in. Pumpcrete pipelines run along the invert concrete from the pumps to a steel-frame and pipe scaffold arrangement 110 ft long and 45 ft high. This scaffold is called the pipe carrier and, when in pouring position, is set tight up against the arch form. The front end of the pipe carrier is built on a 45-deg slope until it reaches the top deck, which is set 6 ft below the roof of the tunnel to provide head room for the workmen (Fig. 3). The top-deck portion is 60 ft long and 15 ft wide, except at the form end, where it extends to the full width of the tunnel to provide a working platform for crews setting and stripping the bulkhead. This top platform supports the three 8-in. Pumpcrete lines, which are mounted on steel guide brackets set at the right level to enter the arch form when it is in pouring position.

When the three pipelines are all set up, the center pipe goes to a hopper mounted just below the front end of the arch form, as shown in Fig. 3. Chutes extending from this hopper on each side, down to four different levels, convey the concrete, through doors in the form panel, so that it fills the form from the bottom. First the concrete is diverted through the lowermost chute until it reaches the level of the bottom door. This door is then closed and the concrete is switched to the next higher chute. The hopper at the top divides the concrete by means of a flip gate, thus directing the flow from one side to the other. All chutes are also provided with flip gates so that the concrete can be diverted from one level to another without stopping the pumps.

The two side pipelines deliver concrete to a second and third hopper-and-chute arrangement, one in the middle of the form and one near the back end of the form. All three Pumpcrete lines are operating at the same time, and the concrete is placed in uniform layers. When the concrete reaches the level of the top chute, all doors are closed and the concrete starts flowing over the top of the arch form. At this point the center pipeline and one side line are extended to reach the back end of the form. The last 60 ft of the extensions are continuous slick pipes, that is, without joints. When the back end of the arch is filled, these slick pipes can be easily pulled out. To do this, a 10-ft length of jointed pipe is removed from each line outside the form area, and the slick pipes are pulled back by an air-driven tugger. The ends of the slick lines are kept carefully buried during pouring.

To be sure the arch is completely filled, a 2-in. air-slugger pipe connection is located in each pipe at the top elbow, near the front end of the carrier. When a pipeline becomes filled, quick-acting air valves are opened and the concrete is forced out and up around the steel ribs and into the high rock crevices in the arch.

At least six 2-in. grout pipes are placed through holes in the form and extended into the higher crevices in the rock. Through these pipes grout is later pumped to fill open seams in the rock and the void created by concrete shrinkage.

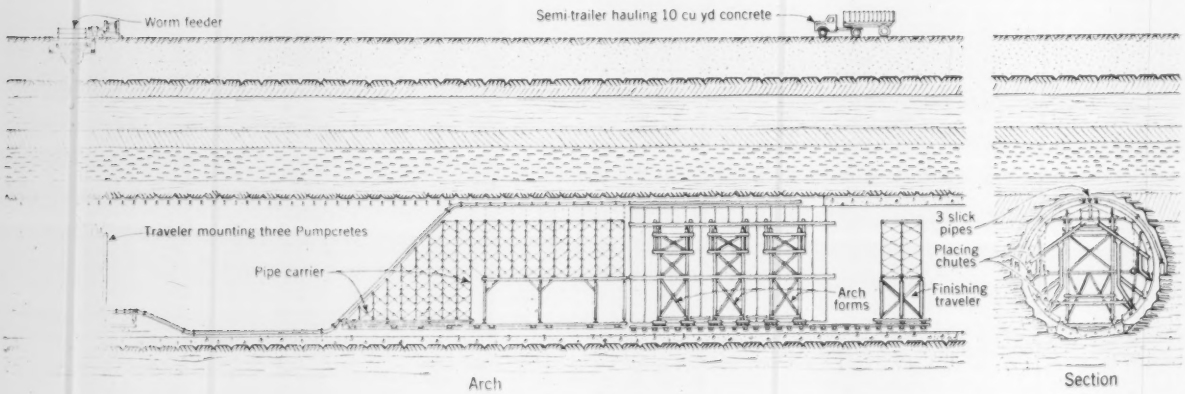
Pouring of the arch concrete for each setting of the traveling form is completed in 6 or 7 hours. Each Pumpcrete machine is rated at 60 cu yd per hour, but has an over-drive setting for faster pumping when conditions are favorable. Normally the fast-pumping arms on these machines are used except when long-distance pumping is required. The slow-speed pump setting is generally used on distances over 1,000 ft. The greatest distance pumped to date has been 1,400 ft.

Concrete is required to set for 12 hours before the form is moved. During this setting time, crews are at work moving the pipe carriage ahead, moving ties, relaying rails, moving pipelines, and cleaning the rock. When ready, the form can be moved in 4 or 5 hours, making the complete cycle in 24 hours. At this rate the concrete arch pour moves along the tunnel at the rate of 70 ft per day, the pours varying from 1,000 to 1,200 cu yd, depending on the overbreak. A finishers' platform, made of a steel frame on wheels supporting a pipe scaffold with wooden decks, follows the arch form immediately after the form is stripped, for any necessary patching.

Two complete sets of equipment like this for placing the arch concrete have been built and are being used each day. One operates between Shafts 3 and 4, and the other at Shaft 5.

When curves in the tunnel alignment are encountered, wedge-shaped fillers are put into the form and taken out again as required.

FIG. 3. Arch concrete falls through down-hole to steel tower carrying chute and three Pumpcrete machines. Three pump lines run up incline of "pipe carrier" to form composed of three 10 × 16-ft steel travelers carrying 70 ft of steel form panels. Cross section shows four-chute arrangement in each traveler.



At the inlet and outlet ends of the tunnel, 30-deg slopes are encountered. These slopes are concreted with a separate form 20 ft long, mounted on a single traveler with special pull beams built in for hauling it up the slope. Three 22½-ton Braden winches, powered with 16.2-hp Pistonair motors, are used to pull this form up the slope. Two are mounted at the base of the traveler, with ¾-in. cables running from the drum to a deadman drilled into the rock at the top of the slope. Four-part lines are used on each winch. The third winch is located at the top of the slope, and its cable is fastened to the top of the form. Since the top of this form is much heavier than the bottom, it has a tendency to lean down hill on the 30-deg slope. The third winch keeps the top of the form in line with the bottom, and also acts as a safety measure.

For each sloped section, a single Pumperete machine was set up at the end of the slope, at ground level, and the pipeline was suspended over the portal and down the invert to the form. It was not unusual at the end of the day to find that 4,000 cu yd of concrete had been poured.

Ninety days after the arch concrete has been poured, grouting operations begin. This work is the final step in completing the tunnel. A grout batching plant is set up on the surface at certain down-hole locations. The grout, for both low-pressure (100 psi) and high-pressure (250 psi) grouting, was mixed in the proportions shown in the box, page 52.

The dry grout materials are hauled by truck from the Hydro Commission's stock piles to the batching plant, which stands over a down-hole and provides ground-level dumping hoppers with elevator conveyors for storing the material in bins set 20 ft off the ground. Under these bins are located two batch mixers where the materials are weighed, batched, mixed with water, and then dumped down the hole.

Two agitator hoppers at the bottom of the down-hole receive the grout, which is then pumped along the tunnel invert by two Gardner Denver 8 × 10 × 5-in. pumps through 1½-in. pipe to two other agitator hoppers located at the point of grouting. The maximum pumping distance is generally about 2,400 ft. From the second agitator hoppers, two other pumps are used to pump the grout into holes previously left in the arch.

Five movable travelers mounted on rubber-tired wheels are employed for the underground grouting setup. One is located under the down-hole and supports the pumps and agitator receiving hoppers. Another supports the two pumps and agitator hoppers located where the grout is being placed. Still another traveler is located between these two pumping stations and one more at each end, making up the total of five.

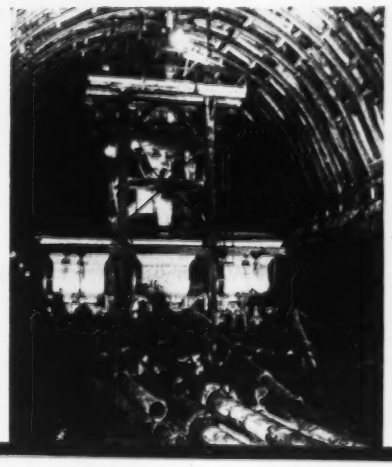
These travelers are all equipped with scaffold working platforms and ladders extending to the tunnel ceiling. The front traveler is used for making up the pipe connections, the second for grout pumping, and the third for disconnecting the grout connections and patching the holes. When the grouting operation has reached its limit in one direction, it is reversed and the receiving agitator hoppers set under the down-hole are moved ahead in the opposite direction and used for the grout-placing unit. The other pumping unit is set under the same down-hole to receive the grout. In this manner the traveler originally at the rear becomes the lead unit for placing the pipe connections. By reversing the whole operation, another 2,400 ft of tunnel is grouted, making a total of 4,800 ft grouted from one down-hole.

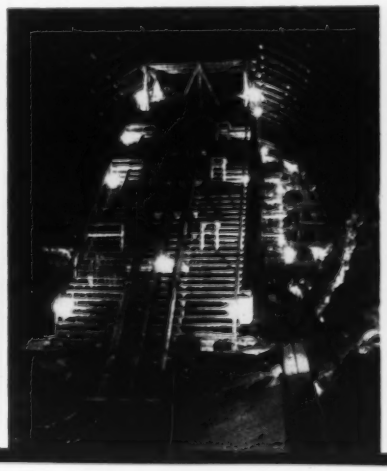
Ends of tunnels emerge on surface at end of 30-deg incline. Concrete in inclined sections was placed by using arch form only 20 ft long, instead of 70 ft as on level sections. Concrete line from single Pumpcrete machine is seen running down tunnel.

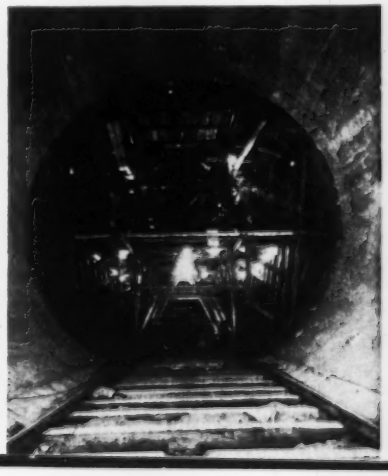
The contract here described covers the concreting of 60 percent of the tunnel length and is for about 600,000 cu yd. The remainder of the tunnel is being constructed by a Canadian company, Rayner-Atlas, Ltd. Placing of the concrete lining was started in February 1953, is about 50 percent along as of October 15, and is planned for completion in October 1954.

The design, engineering, and general supervision of Sir Adam Beck–Niagara Generating Station No. 2 are carried out by the staff of Ontario Hydro with Gordon Mitchell as Project Manager and W. L. Fraser as Project Engineer at the site.

For the contractor, the work is managed by Perini, under the direction of the writer as Project Manager, and Alex Simpson as General Superintendent. The contractor is a joint venture composed of B. Perini & Sons, Inc., Walsh Construction Co., Arthur A. Johnson Corp., Henry J. Kaiser Co., C. A. Pitts General Contractor Ltd., Morrison-Knudsen of Canada Ltd., and Mannix Ltd.

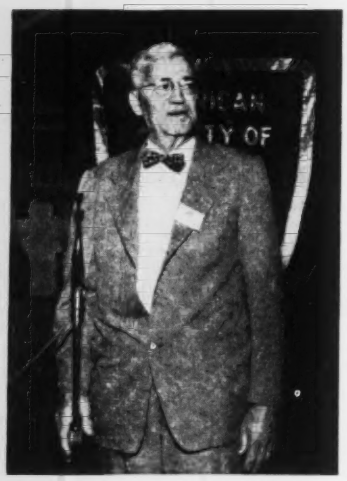






Concrete for arch section is dropped through 12-in.-diameter down-hole and received in 15-cu yd hopper of steel tower in tunnel (left). At point of placement, lines from three Pumpcrete machines run up "pipe carrier" (center) which abuts against arch form seen (at right) from front end. Chutes at different levels deliver concrete into arch form.

More service to the membership—a continuing goal



President's Inaugural Address, Oct. 21, 1953, New York

DANIEL V. TERRELL, President ASCE
Dean, College of Engineering, University of Kentucky, Lexington, Ky.

An unchanging guide to our endeavors is the Society's objective as an organization. This has been stated, restated, lengthened, and shortened in the writing of various constitutions. In today's constitution it reads:

"The objective of the Society shall be the advancement of the science and profession of engineering."

All actions of the Society and its members as a group must be gaged by this standard.

Over the years we have developed a general structure and procedure for operation which has satisfactorily met our needs. A constantly increasing membership, an ever-expanding volume of technical literature, prestige in national and international affairs, direct contributions to the safety and well-being of mankind, and a host of other things tell us that we have achieved a considerable degree of success in attaining our objective.

There are now more than 36,000 members in the Society, assigned to 73 Local Sections. In addition approximately 7,500 students in 133 Chapters at various colleges and universities are affiliated with the parent group. Interest is high and accomplishments are many. On most counts the relationships between the Society and its members are excellent, and the same is true of the Society in its relations with other professional organizations. Yet there are several ways in which each could benefit through more support from the other.

Services Should Be Increased

The Society is in excellent condition financially. Wise investment policies, good management at Headquarters, and constant efforts on the part of the Board of Direction to "cut the suit to fit the cloth" have kept us on a sound footing. This year for the first time the budget has exceeded one million dollars, but in it there is an anticipated deficit of approximately $24,000, which I believe will be avoided by careful adjustment of the budget during the year.

As a group, all of us should, and do, favor operating within the limits of current income, and we appreciate the efforts of the various Boards of Direction in protecting our monetary interests through the years. At the same time we must give recognition to all our personal and professional interests, and make certain that there are sufficient funds to provide all the services that the Society can reasonably offer. There is no wisdom in depriving ourselves of a suit tailored to size simply because there is insufficient cloth to cover the growing boy.

In 1921, when the present dues structure was established, ASCE had almost 10,000 members and an income from dues averaging $18.42 per member. This year we have approximately 36,500 members, of which 47 percent are Junior Members, and despite our million-dollar budget, the average income from dues in 1954 will amount to but slightly more than $13.00 per member. Those are 1921 and 1954 dollars of which I speak, and I need not dwell on the disparity between them caused by inflation in the intervening years.

More Papers Need Publication

Even in the face of these handicaps the Society has managed to expand, or at least to maintain a large part of the services and benefits which members have known and enjoyed at one time or another. In the field of publications—which is the greatest single factor—it became necessary to make drastic revisions in policy and to restrict the distribution of some material. Actually, the total number of papers and articles published has not been reduced, but neither have there been increases to keep pace with the rapidly increasing volume of technical material presented and waiting for publication by ASCE or some other professional organization.

Members far and wide have registered dissatisfaction with former publication procedures, so there is ample evidence that improvements and changes were desired. Possibly the latest revision, by which each individual will receive all the current literature pertaining to his chosen Technical Division will satisfy all concerned, but I doubt it. Greater volume of literature is desired, but providing it and an accelerated schedule for bringing it to the publication stage can only come through a substantial increase in expenditures.

Section and Chapter Support Too Low

Inability to make proper progress in other lines has also been detrimental to the interests of the members. Support for Student Chapters and Local Sections has been undesirably low, although the recent provision for assistance in establishing branches or subsections is an encouraging development at the local level. It has been said before, and I say it again without fear of overemphasis, that the life blood of the Society comes from the Local Sections. One needs only to attend the stimulating Local Section conferences, held in conjunction with Conventions and the Annual Meeting, to realize that the Sections have numerous problems and that they never hesitate to talk about them. Strong ties from the national to the local level have been formed in this way. It would be well if we could cement them through increased allotments.

If the life blood of the Society comes from the Local Sections, creation of that life blood occurs largely in the Student Chapters. I am deeply impressed by the opportunities to develop a broad professional consciousness within these groups, and I fear that we have realized only a fraction of this potential. Trends in membership records, which are bringing the Junior Member grade to the forefront, indicate that the situation is better, but room for improvement is obvious.

We need make no apologies for having been the last of the Founder Societies to provide for Student Chapters, but we are truly at fault if we do not make the most of this opportunity to cultivate professionalism. I fully realize the contributions of time, effort, and sincere interest which have come from individuals in Local Sections and from Society officers and staff. At the same time a very small amount of money has been put into Chapter activities.

Direct support through allotments similar to those provided for Local Sections may be desirable. Still, less tangible support, such as appropriations to cover a large portion of the expenses involved in Student Chapter conferences, could be of even greater value. This is particularly true when the conferences are held as a part of Society Conventions. At this formative stage in professional development, the students gain most from person-to-person contact with those practicing in all branches of civil engineering. Lessons learned on the unfamiliar ground of the Convention are likely to be much more impressive than those which come through similar but more restricted contacts with members attending Chapter meetings on the campus. When the professional lesson is learned at this stage, it is seldom lost.

Regional Offices Merit Reconsideration

Other desirable ties between the Society and its members have been sacrificed because of insufficient funds. Elimination of the regional offices in Chicago and Los Angeles has been regretted by many, even though the arrangement was in existence such a short time that there was hardly an opportunity to prove its merit. The same applies to maintenance of our Washington office at a desirable level of staff and activity. I am certain that if these features were restored in our organization, they would more than pay for themselves in the benefits that could be observed day by day.

The Board has given constant attention to desirable services in relation to available funds. Within the past few months a Task Committee appointed by the Board to study other financial problems has submitted reports, the latest of which was placed before all members in the April issue of CIVIL ENGINEERING. Whether we agree with any or all of the alternatives recommended is not important at the moment. Rather, each member—each Section, each District—must earnestly consider the things that are and could be made available, and then determine whether we can actually afford 1921 dues and the handicaps that go with them.

Numerous other old-time problems are still with us, such as salaries, engineering manpower, collective bargaining, ethics, and the like. These are constantly demanding and receiving attention. A very recent development, by which all professional activities will be coordinated through a Committee on Conditions of Practice, should improve our means of dealing with such problems.

Professional Cooperation Required

In a democratic organization such as ours, there is no problem in our professional life together which cannot be solved with the constructive cooperation of all in our Society. The same applies to relations among organizations having common interests and common objectives. Unfortunately, worthy objectives often can not be reached because of opinionated differences. The pride of affiliation with one organization or another has occasionally served to dull the enthusiasm for shoulder-to-shoulder cooperation between professional groups. Even though engineering has emerged as a profession within a relatively brief period of history, it has reached a maturity that should place all segments above emotional group allegiances which tend to bury coordinated action in an endless and fruitless rivalry.

Cooperative endeavors such as Engineers Joint Council and Engineers Council for Professional Development deserve increased interest and effort from all concerned. This is so not because of the direct benefit that can be anticipated by an individual or organization identified with EJC and ECPD, but because they offer common meeting grounds for better understanding and more effective action within the profession at large. Through such meeting grounds engineering judgment can prevail in all problems of cooperative growth.

Professional Development—a Continuing Process

One such problem needing the best of judgment is an evaluation of the product of engineering training from the day a youngster knows what he wants to be until the last day of his professional practice. Too much reliance has been placed by employers who utilize the product of engineering education—and by the young engineers themselves—on the misconception that a man can be trained so completely during his college days there is no room for subsequent development. Professional as well as technical training should be continuous throughout a man's career, and our society should lend its efforts collectively and individually to the idea of an expanding professional potential. In the process we should be mindful of the fact that the best teaching is done by example.

When registration was first conceived by a committee within ASCE in 1911, and when the various state laws were drafted, the objective was clearly the protection of the public against engineering practice by obvious incompetents. Often this has been replaced by the idea that registration is the final goal or mark of distinction—a laurel upon which one can rest with assurance. We must strive to overcome the idea that registration as a professional engineer signals the end of need for professional training and development.

The basic function of our Technical Divisions and their committees is the professional improvement of our members. Outstanding accomplishments by some of the Division committees have been recognized, and certainly the Society owes a debt of gratitude to those who have given generously of their time and effort in furthering this work. Still, most of the Divisions are faced with problems of participation on the part of their members, and in some cases attention should be given to improved arrangements for meeting times and places. Finally, some Divisions should be stimulated to greater activity, even to the extent of reorganization if necessary.

I am greatly honored to have been chosen for this position of leadership in the year ahead. It is a difficult task, and one in which I invite the help of every member of the Society. In turn, I want to assure you of my best efforts in supporting all our activities.

Typical quadruplex housing unit built for naval personnel at Forrestal Village is shown at left. Single-story duplex units were also included in 318-structure project. Average cost of housing was $8 per sq ft.

WILLIAM R. LORMAN,

Materials Engineer
U. S. Naval Civil Engineering Research and

CARL K. WIEHLE, Jr., M. ASCE,

Structures Engineer
Evaluation Laboratory, Port Hueneme, Calif.

Assembly-line technique results in low-cost concrete construction at

Assembly-line construction procedures employed by the contractors of Forrestal Village, the 1,000-family concrete housing development built for the Navy near the Great Lakes Naval Station, Illinois, resulted in an erection speed of about five dwelling units a day at an overall cost of about $8 per sq ft.

Completed in December 1952, the project consists of 318 single, duplex, and quadruplex structures on 162 acres of Federal land. Although it houses naval personnel attached to the various activities at Great Lakes, it was built by private companies at a cost of about nine million dollars and will be operated by private enterprise until 1990, at which time ownership will be transferred to the Federal Government.

Each family unit consists of a combination living-dining room, a kitchen, a bath, a utility room, and one, two, or three bedrooms. In addition, each unit is provided with an electric water heater, an electric refrigerator, a gas cooking range, and a gas-fired heating apparatus. The smallest unit contains 700 sq ft of floor space and rents for $49 a month. The largest unit has 1,615 sq ft and rents for $110. The average floor space is 970 sq ft. Paved streets, sidewalks, driveways, playgrounds, landscaping, and all public utilities are included in the development.

The buildings are of all-concrete construction in the broadest sense; they demonstrate the notable adaptability of portland-cement concrete to large-scale housing.

The foundations, ground floors, and entrance platforms were cast in place, while the wall panels and the Flexicore units, from which the roofs and second-story floors were made, were precast. Each phase of the work was performed by a separate team whose activities were coordinated with those of the other teams. The result was a production-line technique similar to that employed in manufacturing industries.

Each unit was constructed in three main steps—casting of in-place concrete, erection of wall panels, and placing of roofs and second-story floors.

Foundations and Floor Slabs

Ready-mixed concrete was used throughout the in-place phase of construction. The average mix designs for this and the other phases of construction are listed in Table I. Internal vibrating equipment was used in placing the in-situ concrete, and concrete was poured only when the temperature was between 50 and 90 deg F. Specifications permitted placement at lower temperatures if a means was used to insure that the temperature of the concrete would not drop below 70 deg F during the first three days of aging, and below 50 deg F during the fourth and fifth days. Specifications did not permit the use of calcium chloride. After the concrete was placed, it was sprayed with a transparent membrane curing compound.

Construction of the cast-in-place sections began with the excavation for the foundation walls and sewer-line connections. The foundation walls extend a minimum of 3 ft below grade and taper from a width of 16 in. at the bottom to 8 in. at the top. Concrete piers 2 ft square, and extending the full depth of the foundation, are located under the ends of the party walls. Prefabricated wood panels were fixed in position to form the outer, sloping surface of the foundation wall, and rigid Fiberglas insulation was nailed to studs to form that part of the inner wall which extends above grade. Below grade, the inside face of the excavated trench was used as the form. Concrete was placed in the forms directly from the transit-mix trucks; wood blocks were set into the concrete to act as spacers and as nailing blocks for the floor-slab forms.

The subbase for the ground-floor slab was prepared by assembling the rough plumbing, constructing the gravel fill, and laying a damp-proofing membrane. The subbase proper consists of a thoroughly tamped layer

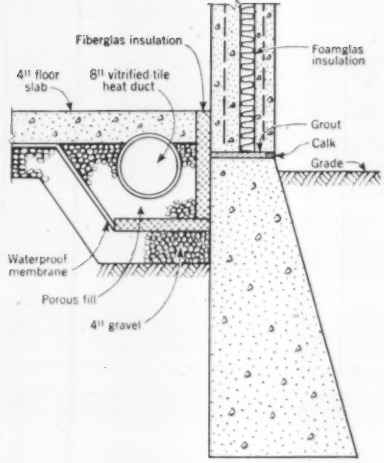


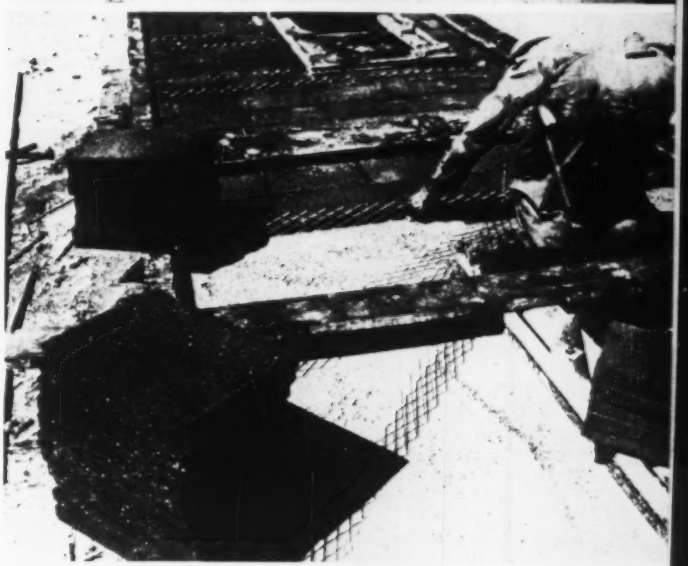
FIG. 1. Detail of floor slab, heating duct, and 3-ft footing shows arrangement of only cast-in-place elements used in structures.

Forrestal Village

of clean, screened, porous gravel not less than 4 in. deep. The heavy, waterproofed, reinforced kraft paper which completes the subbase provides damp proofing and contains the gravel during the laying of the floor slab.

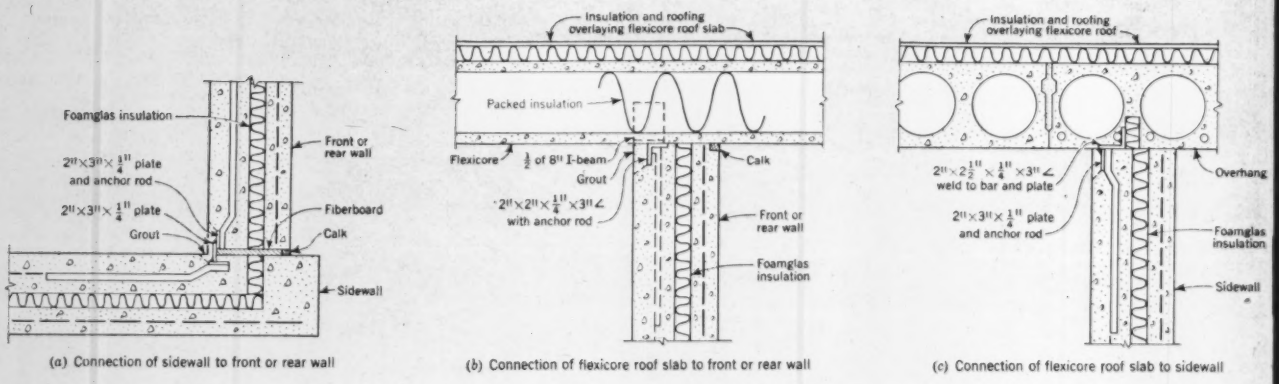
Before the floor slab was placed, the tile heating-ducts and the precast-concrete heater plenum were fixed in position. Concrete was then placed to form a monolithic floor slab 4 in. thick except under the party walls, where the slab was thickened to a minimum of 8 in. so that it would rest on undisturbed soil of good bearing value. Designed for a live load of 40 psf, the slab is reinforced with 6 × 6-in. welded wire mesh (No. 10/-No. 10 wire), placed in well-lapped layers a minimum of $^3/_4$ in. above the bottom. A vertical layer of Fiberglas $1^1/_2$ in. thick, extending 18 in. below the floor line and embedded around the edges, serves as perimeter insulation.

The slab was finished by steel troweling. After curing, the foundation forms were removed, and the excavation backfilled wherever necessary. The foundation was then ready to receive the precast wall sections. To coordinate the construction of the foundations with the production schedule of the precast elements, an average of two foundations a day were laid.



Concrete wall panels are cast on monolithic concrete beds. Inner shell of exterior panel is placed in two 2-in. layers (top photo), so that 4 × 4-in. (No. 4/No. 4) wire mesh reinforcement can be placed. After manual screeding, 12 × 18 × $1^1/_2$-in. Foamglas blocks are laid on plastic concrete (center photo). Shear ties of expanded metal are placed along full length of transverse joints. After final $2^1/_2$-in. (outer shell) of concrete is placed, it is steel troweled, grooved, and broomed for appearance. On wall panels (lower photo) relief mold is indentured into plastic concrete, between windows for architectural effect.

Official Photographs, U. S. Navy



(a) Connection of sidewall to front or rear wall

(b) Connection of flexicore roof slab to front or rear wall

(c) Connection of flexicore roof slab to sidewall

FIG. 2. Wall-to-wall, roof-to-wall, and floor-to-wall connections are extremely simple. Plate and rod connectors are cast in place in structural elements, and field welded when elements are in position. After welding, all joints were sealed by grouting and calking.

Wall-Panel Fabrication and Erection

The exterior and party walls were fabricated at a casting yard located within a radius of $\frac{1}{4}$ mile of the building sites, and the finished units were moved to the sites by specially designed semi-trailers and erected by specialized crews.

Party walls are of solid reinforced concrete but exterior walls are composed of a layer of cellular glass sandwiched between two layers of concrete. The cellular glass (Foamglas) serves as insulation and as a water-vapor barrier. Forrestal Village was the first residential housing project to use this type of wall panel. Ready-mixed concrete, similar in make-up to the in-place concrete, was used, and was similarly placed with internal vibration. No air-entraining agent, integral waterproofing, or coloring was used.

The wall panels were cast in forms laid out on monolithic concrete-slab casting beds, 10 × 300 ft. All walls, even for the largest building in the project, could be cast in one bed. The forms were made of plastic-coated plywood nailed to 2 × 4 wood studs embedded in the casting bed. After the forms were fixed, they were cleaned and the inner surfaces coated with a form oil consisting of kerosene and castor oil mixed in equal amounts. This solution, one of several tried at this project, did not prove entirely satisfactory.

Next, the window and door frames, welding-plate connectors, anchors, lifting plates and hooks, and nailing strips were positioned within the forms and fastened securely. Because satisfactory welded connections between the precast elements depend upon an almost perfect alignment of the connector components, wood templates were used to determine the exact location of all items to be embedded in the panels.

The 4-in. inner shell of the exterior panels was cast in two 2-in. layers so that the precut sheets of wire-mesh reinforcement (4 × 4 in, No. 4/No. 4) could be embedded in it. As the second layer was placed within a few minutes of the first, this shell became a monolithic slab.

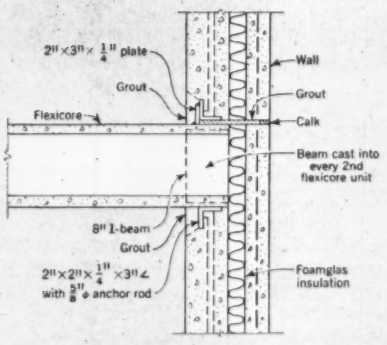
Immediately following strike-off with a manual screed, the 12 × 18 × $1\frac{1}{2}$-in. Foamglas blocks were laid on the plastic concrete. The blocks were hand cut wherever necessary to insure that the openings in the insulation around the door and window frames and in other small areas would not exceed $\frac{1}{16}$ in.

Shear ties of expanded metal, extending the full length of each transverse joint and penetrating through to the inner layer of concrete, were inserted 12 in. on centers between parallel rows of the Foamglas blocks. These shear ties serve also as spacers and as anchors for the outer-shell reinforcement. This reinforcement (2 × 2 in., No. 10/No. 10 wire mesh) was laid on the glass insulation and wired to the shear ties. Extra wire fabric was wired to the primary reinforcement at the corners of the door and window frames to prevent cracking at reentrant angles. The $2\frac{1}{2}$-in. outer layer was then poured.

Exposed surfaces of panels (the outer surfaces of the walls when erected) were finished by steel troweling, grooving, and brooming to give a pleasing appearance. In addition, a relief mold was pressed into the fresh concrete for architectural embossing. During the summer months when the ambient temperatures were high, the panels were moist cured for approximately 72 hours under wet burlap. During the rest of the year, curing mats composed of several layers of Kraft paper interlaid with rock-wool or Fiberglas insulation were laid over the entire casting bed for not less than 60 hours.

After the panels had been cured, they were lifted by a vacuum pad attached to a 20-ton crane onto a specially constructed, rubber-padded A-frame installed on a semi-trailer. Any bond between the concrete and the forms was broken by a hydraulic wedge. The panels were hauled directly to the building site in the proper sequence for erection, which was front, rear, and finally, side walls. The panels were removed from the semi-trailers by a crane specially equipped with a lifting rig that consisted of two hooks attached to a steel beam; the hooks engaged loops cast into the top edge of each panel.

Each panel was set in place on a $\frac{1}{2}$-in. bed of mortar spread on top of the foundation wall, and was positioned temporarily by means of two push-pull tie-rods connected on the one end to plates embedded along the top edges of the inner faces of the panels, and on the other end to the floor slabs. After all walls had been positioned, they were given a final plumbing by adjusting the shoring braces. Rigid vertical connections between contiguous panels were then formed by welding $\frac{1}{4}$-in.-thick steel inserts to combination plate-and-rod



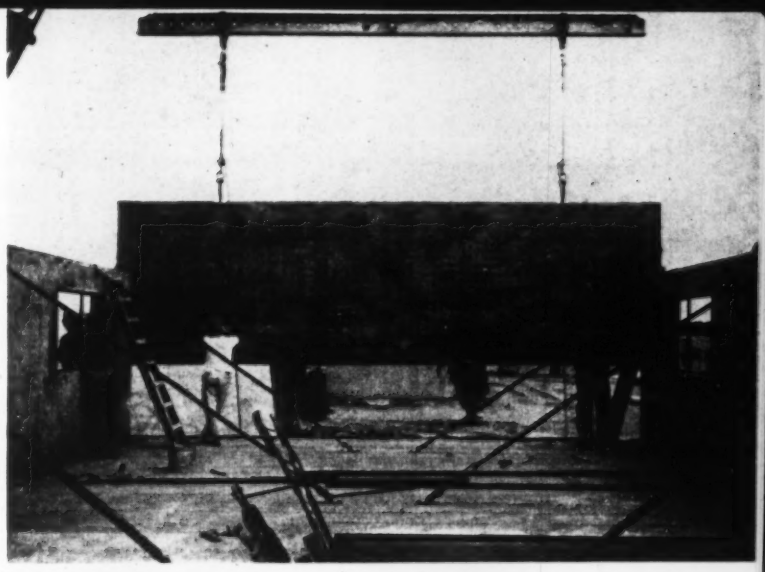
(d) Connection of flexicore floor slab to front or rear wall

connectors embedded near the top and bottom of each vertical edge of the panels.

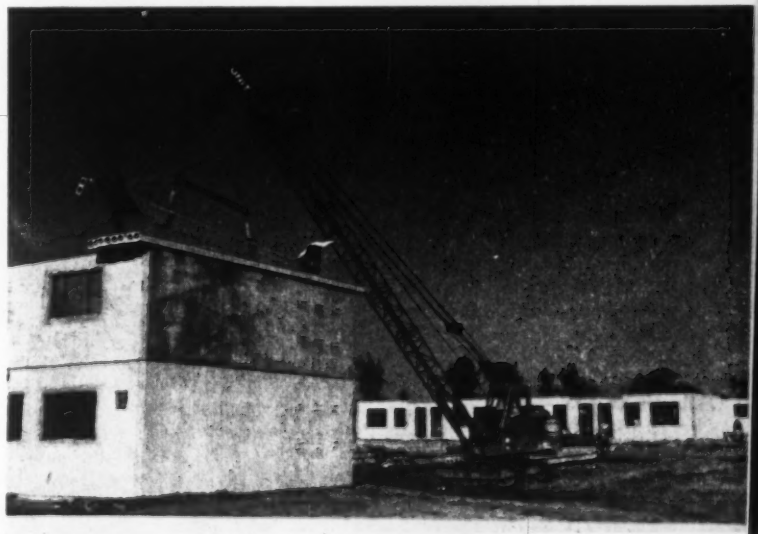
The second-story floors and the roofs of the quadruplex structures were made of hollow precast-concrete (Flexicore) units fabricated under rigid control at the Price Brothers' plant located five miles from the project. The mix design of the concrete used in these units is shown in Table I. Compressive strengths of test cylinders after 28 days usually exceeded 4,000 psi. The units are 16 in. wide and 8 in. deep, with lengths varying according to use, the longest being 28 ft. Each unit contains two longitudinal holes, $6\frac{1}{8}$ in. in diameter, formed around special rubber tubes inflated to the correct diameter.

Before the concrete was placed in the Flexicore molds, which were located on a vibrating platform, the rubber tubes, reinforcing steel, and connector components were fixed at the proper places within the molds. The reinforcement consists of five steel rods (yield point 40,000 psi): a $\frac{1}{2}$-in. round at the bottom center, a $\frac{5}{8}$-in. round at each bottom corner, and two $\frac{1}{2}$-in. round compression rods in the upper portion. Minimum concrete coverage over the reinforcing steel is $\frac{3}{4}$ in.

The bottom rods were tensioned to about 20,000 psi by tightening nuts screwed onto threaded studs welded to the ends of the rods. This stressing of the reinforcing steel served to hold the rods in position during placement of the concrete. According to tests, it also resulted in beams which develop smaller deflections, less tensile cracking, and greater ultimate strength



Precast end-wall, suspended from embedded hooks, is lowered into position by specially rigged crane. Panels are set on $\frac{1}{2}$-in. bed of mortar. Inclined tie-rods support and plumb panels before connections are welded.



Carefully prefabricated Flexicore units are placed in roof of quadruplex structure by 13-tone crawler crane. Holes in concrete are formed by inflated rubber tubes. Reinforcing steel in bottom of each unit—two $\frac{5}{8}$-in. and one $\frac{1}{2}$-in. round bars—are pretensioned to 20,000 psi. Remaining two $\frac{1}{2}$-in. round bars in upper corners are untensioned.

Aerial view of partially completed structure shows how panels are supported during erection. Note panels on trailers in background.

TABLE I. Average mix design for concrete used in Forrestal Village

	Foundations	Ground Floors	Entrance Platforms	Precast Wall Panels	Flexicore Units	Other‡
Minimum 28-day compressive strength, psi	2,000	2,500	3,000	4,000	4,450†	4,000
Slump, in.	5	5	4	3	2½	3
Minimum cement content, sacks per cu yd	4.00	4.50	5.50	6.75	7.40	6.75
Maximum size of aggregate, in.	1	1	1	⅜	⅜	⅜
Net water-cement ratio, by weight	0.75	0.67	0.53	0.50	0.47	0.50
Gravel-sand ratio, by weight*	1.4	1.4	1.5	1.1	1.8	1.1
Aggregate-cement ratio, by weight*	9.0	7.8	6.2	4.9	4.37	4.9
Type of portland cement	I	I	I	I	I	I or III

* Based on saturated surface-dry aggregate.
† Average.
‡ Stairs and stair landings, canopies, chimney enclosures, and garage walls and roofs.

than do ordinary reinforced concrete beams containing an equivalent amount of steel in an equal cross-sectional area.

After the concrete was placed, mold-vibrated, and hand-screeded, the beams were steam cured for 24 hours. The rubber forms were deflated and removed after the first three hours of curing. The Flexicore units were moved to the building site by straddle-type truck carriers in quantities consistent with the erection schedule, about 30 to a load.

At the site, the Flexicore units were lifted into place by means of a sling attached to a 13-ton crane. Because the bottom surfaces of the units, having been at the bottom of the molds, lined up satisfactorily and any variation in the top surfaces was corrected with grout, these units did not have to be worked into place.

After all units for a roof or a second-story floor had been positioned, the connectors joining the units with the wall panels were welded. The Flexicore components for the connection between the roof slabs and the front and rear walls consist of 3½-in. lengths of T-section, produced by halving a standard 8-in. steel I-beam. These T-sections were embedded in an inverted position in every fourth Flexicore unit. The companion pieces in the front and rear wall panels consist of 3-in. lengths of 2 × 2 × ¼-in. steel angle welded to ⅝-in. rounds. The connectors cast into those roof units resting along the side walls consist of 3-in. lengths of 2½ × 2 × ¼-in. steel angle welded to extra reinforcing rods embedded near the bottom center of the units. The 2½-in. legs of the angles were welded to plate-and-rod connectors embedded in the top edges of the side-wall panels.

The Flexicore components for the connection between the second-story floor units and the wall panels consist of 3½-in. lengths of 8-in. I-beams embedded in the extreme ends of every second unit. This arrangement allows the same component to be used in joining the Flexicore unit to both the first- and the second-story wall panels, reducing the number of separate pieces to be positioned in the molds before casting.

After all welded connections were completed, the tie-rods were removed, and the joints between the Flexicore units were grouted with a thin mixture of one part type-I portland cement and two parts sand. The grout was lifted onto the roof or second-story floor in a crane-held bucket and broomed into the keys to form the grouted joints. All other joints between precast elements were filled with an expanded vermiculite weighing 10 lb per cu ft and sealed with an elastic calking compound.

Precast party walls, stairways for the quadruplex structures, canopies, and cement-asbestos interior partitions were erected at the proper time in the assembly sequence.

Finishing Details

For esthetic purposes, hipped roofs were added to the one-story structures; consequently, the Flexicore roof slab is covered only with 1½-in. rigid insulation. The hipped roofs are composed of Douglas-fir rafters covered with 210-lb asphalt-strip shingles laid over 15-lb asphalt rag felt. The open ends of the Flexicore units are plugged for a depth of 12 in. with packed insulation. The exposed flat-roof slabs of the quadruplex structures are covered with a three-ply tar-and-gravel application placed on top of a 1½-in. layer of Fiberglas insulation set in a mopping of coal-tar pitch. Except for the bath, utility, closet, and storage areas, the floors are covered with asphaltic tile. The bath area is covered with ceramic tile set in a bed of mortar composed of one part portland cement and three parts sand. The other areas are not covered.

All exposed interior concrete surfaces were rubbed down with water and hand stones to remove fins and minor imperfections. Honeycombed areas were removed entirely and the cavities filled with neat-portland-cement patches finished to match the texture of the adjacent concrete. All exterior concrete surfaces are covered with one coat of exterior resin-emulsion masonry paint, and all interior surfaces except the floors are covered with one coat of resin-emulsion paint fortified with 25-percent latex.

Finally, the water heater, refrigerator, cooking range, and heating furnace were installed, and all necessary connections made. The hollow cores of the Flexicore units are utilized as ducts for carrying the forced hot air from the heater plenums to the floor registers in the second-story apartments. Openings for the sheet-metal transfer ducts and the floor grilles were cut in the Flexicore units in the field.

As a result of mass production and an assembly-line erection technique, Forrestal Village was built at the unusually low construction cost of approximately $8 a sq ft. The cost of fabricating, delivering, and erecting both the wall panels and the Flexicore roof units was about $1 a sq ft of surface area. The cost of erection alone was not over $0.03 a sq ft.

Prefabricated concrete structures, incorporating new materials and improved construction methods, appear to be the logical means of solving the problem of low-cost housing. The method used in erecting Forrestal Village requires less equipment, personnel, and erection time than does the method used in conventional concrete construction. There seems to be no reason why high-quality construction and economical erection cannot be the standard in future large-scale housing projects when this type of structure and method of construction are employed.

Contractors for the project were the Corbetta Construction Co. of New York, and the Price Brothers Co. of Dayton. These companies retained the services of Shaw, Metz, and Dolio, of Chicago, an architectural firm experienced in the design of large FHA housing projects. A. Amirikian, M. ASCE, of the Bureau of Yards and Docks, was retained as consulting engineer. The FHA was the interpreter of the contractual conditions.

FIELD HINTS

How to avoid cofferdam boils

BYRON J. PRUGH, A.M. ASCE

Assistant Chief Engineer, Moretrench Corp., Rockaway, N.J.

It is often necessary to determine the safe allowable depth for open pumping in a cofferdam. Further pumping and lowering of the water level may result in boiling of the bottom, then piping, then a "blow," in or under the sheeting. Correctly designed and installed, header pipe and well points will dewater an excavation economically for construction purposes. Uplift pressures can be reduced and soil bearing values increased by this means, resulting in a more efficient engineering design.

Sound engineering practice recommends the investigation of the allowable depth of open pumping to insure no starting of the upward movement of the individual grains of the subgrade soil, which may reduce the bearing value of the soil and endanger construction procedures and personnel.

A graph, Fig. 1, giving the suggested safe, allowable pumping depths for cohesionless soils (fine gravels, sands, and silts), has been prepared by the Engineering Division of Moretrench Corporation. The graph is based on the following assumptions and principles taken from the textbooks of Dr. Karl Terzaghi, Hon. M. ASCE, and Dr. Donald Taylor, A.M. ASCE. These assumptions must be interpreted and understood by the engineer using the graph in the field. They are:

1. The soil is assumed to be homogeneous, cohesionless, granular. Such a soil is usually never found in nature. The presence of relatively thin layers of silt and clay have a considerable influence on the flow net and are usually not detected by ordinary drilling, boring, or sampling methods.
2. Failure occurs within a depth of $D/2$ of the sheeting.
3. Darcy's law holds.
4. The coefficient of permeability, k, is greater than 0.03×10^{-4} cm per sec. Below this limit, it is arbitrarily assumed that the soil is so fine grained or graded that turbulent flow exists under high heads or that the cohesive forces become the governing factors.
5. A typical flow net, as shown in Fig. 2, is assumed.
6. A 100-percent factor of safety is assumed. This means that the values of H given in the graph, Fig. 1, can be exceeded, at the discretion of the engineer.

The effective use of the graph depends on two factors. The first of these is the ability of the engineer in the field to determine the average effective weight (submerged weight) of the soil in the cofferdam. This requires ingenuity on the part of the engineer, using one of the following three methods:

1. If an undisturbed sample is available from borings (which is most unlikely) the submerged weight is easily obtained by simple calculations.
2. A disturbed sample may be obtained and a graph plotted of the submerged weights from the loosest to the densest states (maximum and minimum relative density). From the blows of the borings or the experience of the engineer, the relative density may be assumed and the submerged weight may be estimated.
3. The engineer may take a container of known volume and attempt to get a relatively undisturbed typical sample from the bottom of the cofferdam, which fills the container to the top. If, from the weight of this container filled with soil and water, he subtracts the weight of the container filled only with water, he will get the submerged weight for the volume of the container. This can easily be converted to the conventional unit of pounds per cubic foot used in the graph.

The second factor, on which success in using the graph depends, is the effective depth of penetration of the sheeting below the bottom of the excavated subgrade, assuming that the sheeting acts as a cutoff and that the flow lines pass under the bottom of the sheeting as shown in Fig. 2. Leaky sheeting reduces the safe allowable pumping depth.

The graph, Fig. 1, shows submerged weights ranging from 20 to 80 lb per cu ft. However, it is rare in nature to encounter soils of high permeabilities with weights greater than 70 lb per cu ft or lower than 40 lb per cu ft, especially when quartz is the basic substance composing the grains. Where substances other than quartz, such as pumice, predominate in a soil, the submerged weight may drop as low as 10 lb per cu ft. This is an extreme case, but one actually encountered by the writer in Salvador, Central America.

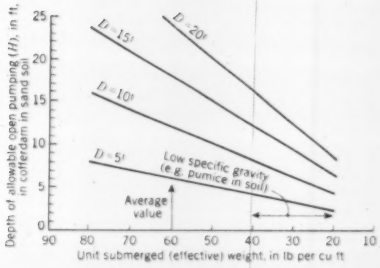


FIG. 1. Graph prepared by Engineering Division of Moretrench Corporation (copyright August 1953), Rockaway, N.J., gives safe depth for pumping, in feet, in open cofferdam in homogeneous granular pervious sand, from very fine to coarse. For definitions of D and H, see Fig. 2.

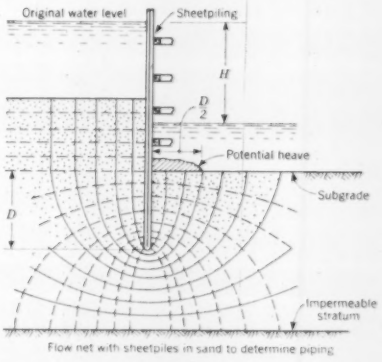


FIG. 2. Typical flow net is assumed in preparation of graph, Fig. 1. Leaky sheeting would reduce safe allowable pumping depth.

It is realized that the effectiveness of the use of this graph in the field depends on the engineer's ability to approximate the effective (submerged) weight of the soil and the effective depth of the sheeting, and then to apply the proper safety factor. Nevertheless any individual computations would necessitate identical assumptions. The graph therefore is not only a ready reference but should save the field engineer considerable mathematical calculation. It should be borne in mind that the use of this graph cannot be considered as a guarantee that "boiling of the bottom" will be prevented, or will occur, for a specific set of conditions. Instead the graph should be considered as an engineering guide to be tempered by the experience and judgment of the user.

Hydraulic jump in irregular cross-sections computed by time-saving method

DANIEL D. HOWELL
2nd Lt., U.S. Air Force

The need for computing the height of a hydraulic jump will be evident to engineers concerned with open channels in which water flowing at high velocity is suddenly retarded—the proper conditions for the jump phenomenon (Fig. 1). This phenomenon is commonly observed below the spillway of a dam, where the overflow has a much higher velocity than the tailwater.

At present, there are two necessary evils in computing the height of a hydraulic jump:

1. For each cross section of a natural river, man-made channel, or other open-air device in which water is flowing, laborious curves must be plotted.
2. Every time the flow changes, new time-consuming curves must be plotted.

Both these requirements make the present method of estimating the jump long and tedious. A typical graph for a particular cross-section and for a constant flow, Q, is shown in Fig. 2. The ordinate of this graph is Z (depth of flow), and the abscissa is $(Q^2/Ag) + Ay$ (the force causing the jump), in which Q, is discharge; A, cross-sectional area; g, acceleration of gravity; and y, depth to center of gravity of cross-section. With a constant Q, the variable Z will determine each of the other values. The two intersections of a straight vertical line and the curve determine the depth both before and after the jump. After the curves have been plotted, it is a relatively simple matter to determine the jump, but of course, as has been mentioned, whenever the flow changes or a different cross-section is desired, new curves must be plotted.

However, if Ay is plotted on the vertical axis and $1/Ag$ on the horizontal axis, with Z again as the variable (a change in Z causes a corresponding change in A and y), the curve takes the shape of that shown in Fig. 3. A straight line with the slope of $-Q^2$ will intersect this curve at two points, thus giving two values of Ay on the vertical axis. Each value of Ay has only one corresponding value of Z for a given channel cross-section. And since Z is the value sought, it can be found by the use of the Z-line (Fig. 3), which, in turn, is obtained by plotting Z against Ay.

The proof of the validity of this new method is as follows:

$\frac{Q^2}{A_1 g} + A_1 y_1$ must equal $\frac{Q^2}{A_2 g} + A_2 y_2$

as in the old method. For when the vertical line intersects the curve, as in Fig. 2, both points have the same value on the abscissa.

The equation for a straight line is

$$y = mx + C$$

where y is the value of the ordinate; x, the value of the abscissa; C, the y-axis intercept; and m, the slope of the line.

Thus the straight line in Fig. 3 has the equation,

$$Ay = (-Q^2/gA) + C \quad \ldots\ldots (1)$$

where Ay is the value of the ordinate; $1/Ag$, the value of the abscissa; C, the y-axis intercept; and $-Q^2$, the slope.

So if the values of Points 1 and 2 in Fig. 3 are substituted in Eq. 1, the resulting equations will be

$$\text{For Point 1, } A_1 y_1 = -\frac{Q^2}{A_1 g} + C \quad (2)$$

$$\text{For Point 2, } A_2 y_2 = -\frac{Q^2}{A^2 g} + C \quad (3)$$

Now if Eq. 3 is subtracted from Eq. 2, the result is

$$A_1 y_1 - A_2 y_2 = -\frac{Q^2}{A_1 g} + \frac{Q^2}{A_2 g} + C - C$$

And after transposing

$$\frac{Q^2}{A_1 g} + A_1 y_1 = \frac{Q^2}{A^2 g} + A_2 y_2$$

The intersections of the various lines and curves may be so flat as to require careful construction to insure the desired accuracy of reading. Therefore both the horizontal and the vertical scales should be meticulously selected.

The obvious advantage of this new time saver is that every time the flow of a stream changes, the same curve may be used. The only change involves that of the slope of the straight line which depends directly upon the flow ($m = -Q^2$).

A second advantage is that if two heights are known (height before and after the jump), the Ay value can be determined, a straight line plotted, and the flow, Q, can be found by determining the slope of the straight line. This is impossible by the old method. Although this system cannot of course be taken as the last word in hydraulic-jump short-cuts, it is certain to save a great deal of time for engineers who use it.

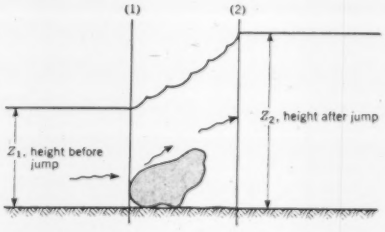


FIG. 1. Hydraulic jump results in abrupt rise in water surface.

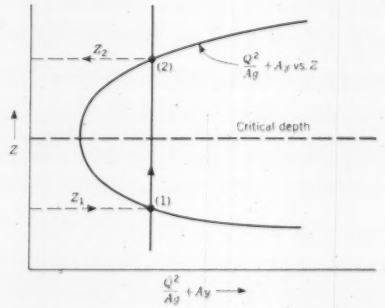


FIG. 2. Typical graph for a particular cross-section and for constant flow, Q, has ordinate Z (depth of flow) and abscissa $(Q^2/Ag) + Ay$ (force causing jump).

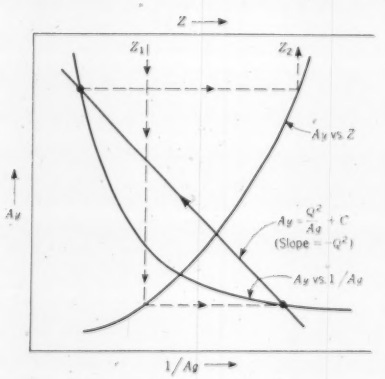


FIG. 3. Plotting of Ay on vertical axis against 1/Ag on horizontal axis, gives curve from which various values of Z can be obtained.

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THE READERS WRITE

Gunite vs Grouting for Earth-Dam Foundations

To the Editor: It is agreed that the method of grouting a cutoff curtain under an earth-fill or clay-core dam, as mentioned in the letter to the editor by Fred H. Lippold in the July issue (p. 62), is amply effective in quite a few cases. Some engineers object to blasting in a trench for fear of leaving disturbed rock in place, with open joints. However, it will be assumed that the cracks are grouted up and become a part of the solid foundation.

With the concrete-filled trench, some additional resistance against leakage during grouting is obtained, equal to the depth of the trench. With a gunite cover applied clear across the base of the clay contact, as at Kenney Dam, much more resistance is obtained and higher grouting pressures can be used. Where grout leaks to the surface near the hole, it takes time to plug the leaks so that pressure can be applied to force the grout out into the rock. The leaks are generally at the top of the hole. While the leaks are flowing at low pressures, the lower part of the hole fills more or less by sedimentation, and when pressure is finally applied, the small cracks and seams have already been sealed off by sedimentation.

There are certain other advantages in using a gunite cover that should not be overlooked. Where the rock is such as it was at Kenney Dam, with numerous small pockets so small and deep that they cannot be packed with clay by regular air tampers, the holes can be filled with gunite to the point where hand or air tamping will do the job. No attempt is made to fill them flush with the surface.

A second point is that where the rock in the core trench is not thoroughly grouted to consolidate it against leakage, the gunite membrane will force all seepage water to travel the full thickness of the clay core rather than leak upward here and there over the upstream portion of the core trench and, after traveling a short distance through the clay, escape downward through the rock below the cutoff.

It must be remembered that it is difficult to discuss grouting problems where the two parties to the discussion are not considering exactly the same conditions. All-over guniting is not always recommended. It depends on the rock at the site.

Gunite is not cheap, but sometimes it is worth while.

I have used the packer system, working from the bottom up, and lost a few holes because of grout running around the packer and hardening on top. I really see no particular advantage in operating that way except for the saving in drilling the entire hole at one setup.

James B. Hays, M. ASCE
International Engineering Company Limited
Vancouver, British Columbia

Steel-Pile Foundations for Buildings Do Not Corrode

To the Editor: The idea of using steel piles for permanent foundations was received by engineers, 40 years ago, with about as much enthusiasm as was Galileo's theory of the solar universe by his contemporaries in the 17th century. In his case, he had developed a telescope that could peer up into the heavens to prove his contention. But in the case of the steel piles, for a long time there was no means available for peering in the opposite direction, into the earth.

Civil engineers were taught that steel oxidizes rapidly when exposed to the atmosphere, and experience confirmed this fact. Any argument to the contrary was heresy. Galileo was put in jail for his opinions. In my case the penalty was less drastic, but some mental disorder was hinted.

One day my attention was called to the excavation for a building located a considerable distance back from the existing bulkhead line on the North River in New York City, but not as far back as the original shore line. The hulk of a small vessel had been uncovered where it had been buried by filling operations. There was nothing new in discovering that the timber in the hull of the schooner was as sound as the day it was built, but the discovery that the anchor chain was also well preserved, and still in usable condition was a great surprise, especially since it had initially been exposed to salt water which would start oxidation. Oxidation of the anchor chain had been arrested for the same reason that the timber in the hull had been preserved—because the oxygen supply had been cut off. A section of the chain, under glass, was a treasured exhibit in my office for many years.

About this time I saw the first steel-pile foundation in New York City under construction. Steel pipe piles, driven open end to rock by a pneumatically operated hammer, were being blown out with compressed air and filled with concrete. The pipe was in 20-ft lengths. When a length had been driven to ground level, a cast-iron sleeve was inserted, another length of pipe was added, and the driving process continued. The sleeve was a crude affair with a small lug cast on one side, which extended through a slot in the upper end of the pipe length already driven. The jar of the hammer frequently sheared off this lug, causing the pipe to telescope.

Our company immediately saw the great possibilities of this type of foundation and began to install it wherever a customer could be found. The design of the sleeve was improved so as to avoid the possibility of telescoping the pipe lengths. The new design consisted of a fillet cast entirely around the center of the sleeve. The ends of the adjacent pipe lengths rested on the fillet, and as the sleeve was a driving fit, the pipe sections were held firmly in place and all danger of telescoping was avoided. A patent was obtained in my name on this sleeve but the manufacturer was permitted to sell to the trade, and its use soon became standard practice. This sleeve is still universally used wherever pipe piles are driven.

Under certain conditions the steel-pipe foundation was much cheaper than any other design. The cost of underpinning adjacent buildings where open caissons were required was frequently avoided. The open-end pipe greatly reduced vibration and could be driven close to building walls so that cantilever construction was avoided and time was saved—an important consideration on any project.

The engineering profession, however, was still skeptical of the permanence of steel for foundation purposes. Engineers to whom I showed the chain, previously mentioned, said it was made of wrought iron with a low carbon content, whereas steel pipe was much higher in carbon and therefore subject to more rapid deterioration from rust.

Passing the excavation of a large building foundation in the Wall Street district of New York one day, I observed that the wall of a tall adjacent building was underpinned by pipe piles of large diameter. These piles, which were exposed by the excavation for lengths of 10 or 12 ft, had been in the ground for about 18 years and were as black as the day they left the rolling mill. The supply of oxygen had been cut off and they had not been attacked by rust.

From that time on the steel pipe pile assumed its proper place in foundation design. For several years some of the more conservative foundation engineers made a certain allowance for the oxidation of the outer surface of steel pipe in calculating bearing capacity, but this practice has since been abandoned. Today the building codes of most cities in the United States give a fixed bearing value for the steel and concrete in pipe piles, and the design of this type of foundation is now standardized.

The success of the steel pipe pile and its universal acceptance by civil engineers as a permanent type of foundation suggested the idea of the H-beam steel pile to several of the large steel companies, and this type of pile has now been in successful use for many years. In many instances it is found cheaper than the pipe pile, as no concrete is required. It can be rolled in longer lengths than the steel pipe, which is often an advantage. When the pile is of considerable length however, the sections of the H-beam are spliced by welding in the field.

I have never heard of the failure of a steel-pile foundation.

Francis L. Pruyn, M. ASCE
President, Underpinning and Foundation Co., Inc.
New York, N.Y.

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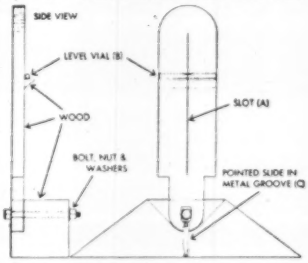

"Use good, dry hardwood. The upright section should have a 1/32" slot *(A in diagram)*, through which light is visible. A bracket on the reverse of the upright—fastened at right angles to longitudinal slot—holds a level vial *(B)*. The slot is vertical when vial is level.

"The upright section is held to a base by a pivot bolt. Also attached at the bolt is a pointed metal slide, moving in a metal groove *(C)*. This slide moves through a line which is a projection of the vertical slot. It can be extended to position the slot accurately over a point on sloping terrain.

"At night I use a three-battery flashlight, held by a wire frame behind the slot. By day, the sun is reflected through the slot by a mirror. Having used mirrors in the national forests, I recommend them for day work. For day or night work, I recommend my Gurley reticle. It makes any problem a pleasure."

Level on stilts

Have you tried this method for leveling over corn fields or groves of fruit trees? Letters from all over are telling us how surveyors are finding this short cut helpful. All you do is remove the sliding legs from your extension tripod and replace them with lengths of one-inch thinwall conduit.

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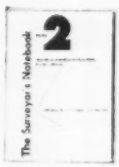
Leveling over Ohio corn field.



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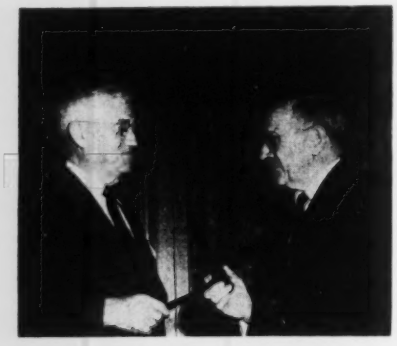
SOCIETY NEWS

Notable Technical Program, Induction of Officers, and Award of Honors Feature Successful Annual Convention

A new high in ASCE meetings was the verdict of the nearly 2,000 attending the Society's 1953 Annual Convention, held at the Statler Hotel in New York, October 19–23. In addition to such traditional Annual Convention features as the induction of new officers and the presentation of honors and awards, the program offered exceptional technical coverage—thirty-four sessions occupying four full days and representing all the Technical Divisions of the Society. With mass transportation the general theme of the convention, a number of sessions dealt with different aspects of the subject and notably with the engineering innovations involved in design and construction of the half-billion-dollar New York State Thruway, connecting New York City and Buffalo.

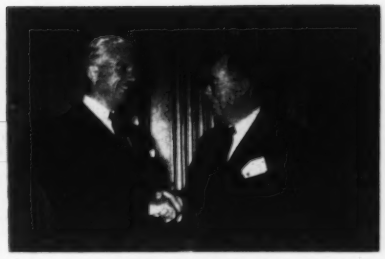


Director Louis R. Howson, chairman of the Committee on Publications, presented the awards to authors of prize-winning papers in Volume 117 of TRANSACTIONS (September issue of CIVIL ENGINEERING, page 70, for the details). Retiring President Walter L. Huber was in the chair. An unusual feature of the Wednesday morning business meeting was the presentation of a Scroll of Appreciation to Sydney Wilmot for thirty years of service to the Society in key positions in its publication work. Mr. Wilmot, who retired a few months ago as Manager of Technical Publications, spoke feelingly of the inevitable satisfactions involved in publishing the technical annals of an organization like the Society and expressed his gratitude to the pioneer members, "now almost legendary," whose cooperation he enjoyed in his work.

New Officers Inducted

At the close of the Wednesday morning session Daniel V. Terrell, dean of the College of Engineering and director of the Engineering Experiment Station at the University of Kentucky, took office as 85th president of the Society. Also inducted into office were two Vice-Presidents—Enoch R. Needles, of New York City, for Zone I and Mason G. Lockwood,

Daniel V. Terrell (left, in upper left photo) receives gavel he will use during his forthcoming year as President of ASCE from retiring President Walter L. Huber. In view at immediate left Sydney Wilmot (left) is awarded Committee on Publications Scroll of Appreciation by Louis R. Howson, chairman of committee, in recognition of his thirty years of service on Society publications. Lower left photo was snapped at Sanitary Engineering Dinner and shows (in usual order) Rolf Eliassen, member of the Executive Committee of the Sanitary Engineering Division; George H. Shay, staff manager, Johns-Manville Sales Corp., and featured speaker; and A. J. Fischer, sanitary development engineer, the Dorr Co. Two new ASCE Honorary Members are introduced to each other by President Terrell (lower right photo) at annual dinner dance, where presentation of their awards was made. Shown, in usual order, are Honorary Member Arthur E. Morgan, President Terrell, and Honorary Member O. H. Ammann.



Scenes from four Technical Division Luncheons, an important feature of Annual Convention week, are depicted on this page. At the Construction Division's Mass Transportation Luncheon (left in top-left view) are the speaker Marcus Nadler, economist for the Central Hanover Bank and Trust Co., and C. Douglas Riddle pinchhitting for Toastmaster Arthur E. Poole. Bertram D. Tallamy (left, top center), chairman of the New York State Thruway Authority and speaker at the Highway Division Luncheon, is shown with Toastmaster G. Donald Kennedy. Wednesday Membership Luncheon was addressed by Undersecretary Ralph A. Tudor (right, top right), who is shown with Raymond L. Brandes, Convention chairman. Edmund A. Prentis (left, photo at right center) is greeted at Soil Mechanics Division Luncheon by presiding officer Arthur Casagrande. On the table there is a cross section of a piece of water pipe, laid down in New York City about 160 years ago by the Manhattan Co. and excavated by Mr. Prentis' firm, Spencer, White & Prentis, during the building of the William St. subway in 1915 and displayed by Mr. Prentis during his talk. Retiring President and Mrs. Walter L. Huber are seen at dinner dance in lower right view.

of Houston, Tex., for Zone IV. The new Directors are W. S. La Londe, Jr., District 1; Oliver W. Hartwell, District 4; Thomas C. Shedd, District 8; Samuel B. Morris, District 11; Ernest W. Carlton, District 14; and Raymond F. Dawson, District 15.

Increased service to the membership was emphasized as a continuing Society goal by Dean Terrell in his inaugural address (see page 56). Some of the fields in which there is room for such expanded service are publications and Section and Student Chapter support, which he termed "undesirably low." Pointing out that the ASCE dues paid today are the same as in 1921, despite the inflated dollar, he said, we "must earnestly consider the things that are and could be made available, and then determine whether we can actually afford 1921 dues and the handicaps that go with them."

Undersecretary Tudor Speaks

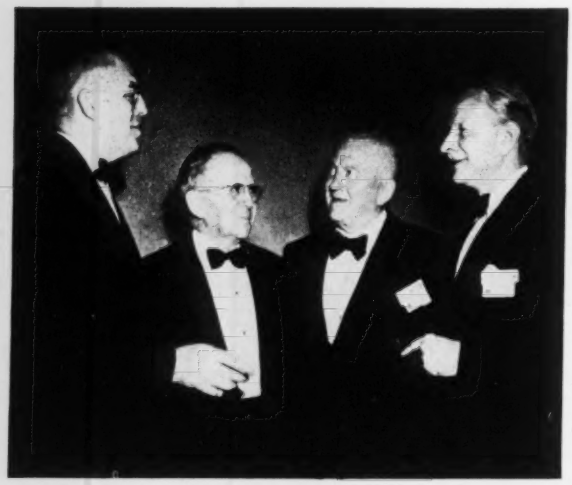
There was an unusually large attendance at the annual Membership Luncheon on Wednesday to hear Ralph A. Tudor, M. ASCE, Undersecretary of the Interior, speak on the government's policy concerning the generation, distribution, and sale of federal electric power. Noting that there are "deep and divergent convictions on the subject throughout the country," Mr. Tudor said that the government is pursuing a middle-of-the-road policy, advocating a partnership between government and local interests, with the Federal Power Commission the proper licensing agent. It is not in competition with local interests, he emphasized.

"Contrary to past practices," Mr. Tudor said, "we will not oppose the construction of generating facilities by local interests either public or private when these local interests are willing and able to provide the facilities in accordance with licenses properly issued by the Federal Power Commission. . . . The Department of the Interior will continue to plan and recommend construction of those projects that are economically sound, of advantage to the community, and where the local interests, either public or private, cannot perform the work themselves. Generally this will be the large multiple-purpose projects which because of their size, or non-reimbursable features, or interstate complications are beyond the means of local effort."

Technical Division Luncheons

Luncheons keynoted to the Convention theme of mass transportation were sponsored by the Highway Division on Monday and by the Construction Division on Thursday. Bertram D. Tallamy, M. ASCE, chairman of the New York State Thruway Authority, was principal speaker at the Highway Luncheon with an address on organization and operating procedures of the Authority. His paper heads a symposium printed elsewhere in this issue. The Construction Division luncheon posed the question, "Mass Transportation—Can We Afford It?" which was answered in the affirmative by the featured speaker, Dr. Marcus Nadler, economist for the Central Hanover Bank and Trust Co. Said Dr. Nadler, "the nation's economy can meet the transport deficiency," and for the method of financing he advocated a use tax rather than any additional direct taxes. According to Dr. Nadler, "All indications are to the effect that the economy of the country is headed for a readjustment, and during this period meeting the transportation deficiencies could, to a considerable extent, counteract a decline in business activity. From the economic point of view, therefore, the question is not whether we can afford it but rather whether we can afford not to go ahead and meet the transportation deficiencies."

Other social events supplementing the rich technical program were a Soil Mechanics Luncheon on Tuesday, sponsored by the Soil Mechanics and Foundations Division and featuring a talk by Edmund A. Prentis, M. ASCE, on his experiences as a New York foundation contractor, and a Sanitary Engineering Dinner, which was addressed by George H. Shay, staff manager of the Johns-



In one Annual Convention get-together ASCE Secretary W. N. Carey and President Huber find time for a chat with professional neighbors to the north—Ross L. Dobbin and Austin Wright, president and secretary of the Engineering Institute of Canada.

Attending meeting of ASCE-AIA Joint Cooperative Committee, held during Annual Convention week, are (seated in usual order) Lawrence S. Whitten, AIA; Frederick J. Woodbridge, AIA; Joseph H. Ehlers, ASCE Field Representative and co-secretary for ASCE; Craig Hazelet, co-chairman for ASCE; Roy F. Larson, co-chairman for AIA; G. Brooks Earnest, ASCE (Vice-President); Mason Lockwood, ASCE (Vice-President); and Theodore Coe, co-secretary for AIA.

Seen at speakers' table during Regional Conference of Student Chapers (left to right, immediately above) are ASCE Vice-President Enoch R. Needles, who addressed the group on toll roads; ASCE President Daniel V. Terrell; Howard Christensen, Conference chairman; and Allen P. Richmond, Jr., assistant to the Secretary.

Manville Sales Corp. The dinner was a special event, celebrating the expanded program of the Sanitary Engineering Division that includes recent formation of a Sanitary Engineering Group within the Metropolitan Section.

Technical Division Program

A Sanitary Engineering Division session which attracted wide attention dealt with atmospheric pollution, with particular reference to conditions in New York. The Thursday morning Structural Division session elicited the close attention of a large audience, with papers on "Lateral Buckling of I-Beams Under Thrust and Unequal End Moments" by M. G. Salvadori, and the Mackinac Straits Bridge by D. B. Steinman coming in for much discussion. Of much interest, also, was the program of the Soil Mechanics and Foundations Division—especially the session reporting the significant developments of the recent International Conference on Soil Mechanics and Foundation Engineering at Zurich, and the joint session with the Highway, Construction, and Structural Divisions, in which Emil H. Praeger, M. ASCE, described innovations employed in constructing the foundations of the Thruway Bridge being built across the Hudson between Nyack and Tarrytown. Authors' breakfasts every morning served as briefing sessions for the participants in the program and assured smooth-running technical sessions.

A number of the meeting papers are printed as articles in this issue. Others, including the addresses by Tudor, Nadler, and Praeger, are scheduled for December CIVIL ENGINEERING. In keeping with the new method of handling ASCE technical papers, the Convention papers were reproduced as Proceedings Separates in advance of the Convention and enjoyed a lively sale during the four-day program.

U.S. Steel Plant Visited

Supplementing the technical papers, several of the Divisions sponsored trips to projects under discussion. Among these were a Waterways Division inspection trip to Pier 57 under construction on the North River, and a Highway Division excursion up the Hudson River to inspect construction of the Thruway Bridge. One of the meeting highlights was an all-day excursion, on Friday, to the recently opened Fairless Works of the U.S. Steel Corporation at Morrisville, Pa., where the steel-making process and the rolling of sheet were observed. In addition, the group of 450 making the trip had an opportunity to see the various utility installations included in the huge development, one of the largest steel-making facilities in the

Representatives from Sections in the Northeastern area attend two-day Local Section Conference held during Annual Convention. Shown here (seated, left to right), are Mason C. Prichard, District of Columbia Section; George H. Hoffmire, Conference recorder; Howard M. Turner, Northeastern; and John P. Riley, Frank C. Mirgain, and Jewell M. Garrelts, Metropolitan. Standing, in same order, are John N. Eckle and Earl R. Howard, Connecticut; W. R. Kahl, Maryland; Clyde Coats, Syracuse; John Morton and Hamilton Gray, Maine; Don P. Reynolds, Assistant to Secretary; John A. Focht, Conference chairman; Clyde B. Pyle, Philadelphia; Ernest Smith, Virginia; Harold Bateson, Rhode Island; E. K. Muhlhausen, Lehigh Valley; William P. Simpson, Philadelphia; Bruno Chape, Ithaca; and Holbert W. Fear, Hudson-Mohawk.

East. The bus trip over the New Jersey Turnpike to Morrisville gave visitors to the East a chance to see this important new arterial route.

Notable Social Program

For recreation during the week of technical and business sessions, hard-working committees of Metropolitan Section members and their wives had arranged a notable social program. Highlights of the program included the annual dinner dance on Wednesday night, at which honorary membership was awarded to O. H. Ammann and Arthur E. Morgan (illness kept the other two recipients—John C. Page and Charles M. Spofford—from attending); the men's smoker and entertainment; an exceptional ladies' program under the chairmanship of Mrs. Raymond L. Brandes; and a number of college and fraternity dinners and reunions throughout the week.

Student and Local Section Conferences

The many other events of Annual Convention week included a Student Chapter Conference—sponsored by the Metropolitan Conference of Chapters and featuring a talk on toll roads by Vice-President Needles and an address by President Terrell—and a two-day conference of representatives of Local Sections in the northeastern area. The agenda for the Local Section Conference included discussion of effective Section programs as an aid in obtaining good meeting attendance and member participation; organization and operation of Subsections and Branches; relationship of Sections to other engineering groups in the area; cooperation with Student Chapters in the area; a program for developing professional consciousness; and organization of Local Section professional activities. Operational problems, such as ways of stretching Local Sections funds through close control of expenditures and the integration of Junior Members into Section responsibilities and activities, occupied another session. John A. Focht, of the Texas Section, was conference chairman.

Committee Personnel

Raymond L. Brandes as general chairman and Jewell M. Garrelts as vice-chairman headed the committees responsible for the memorable Convention.

Actions of ASCE Board of Direction Briefed

Principal actions of the ASCE Board of Direction, taken at its meetings during the Annual Convention in New York, October 19–23, are summarized here.

Alfred Noble Prize Awarded

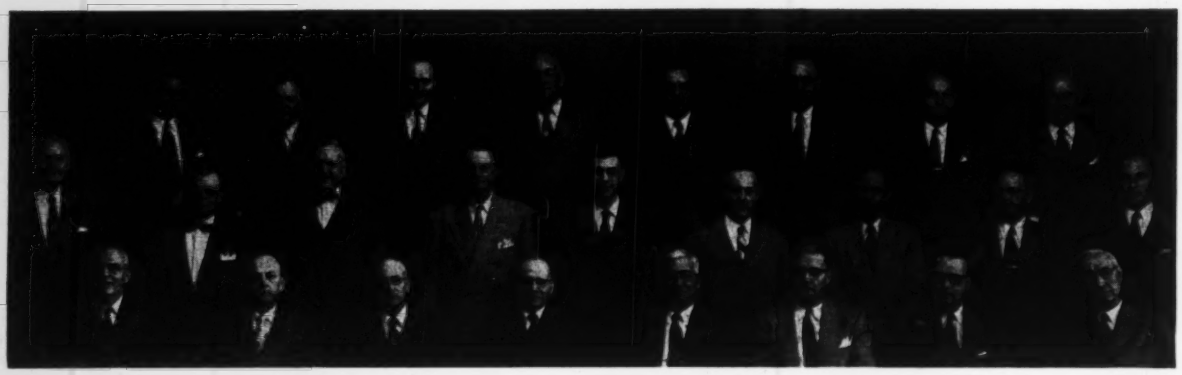
Award of the Alfred Noble Prize for 1953 to Henry M. Paynter, Jr., J. M. ASCE, Cambridge, Mass., for his paper, "Electrical Analogies and Electronic Computers; Surge and Water Hammer Problems" (published as Proceedings-Separates No. 146, August 1952), was approved.

Appointments to Technical Division Executive Committees Made

The Board approved the appointment of Frederick W. Tuemmler, of Washington, D.C., to the Executive Committee of the City Planning Division, and of Bertram D. Tallamy, of Albany, N.Y., to the Executive Committee of the Highway Division.

Sections to Have Voice in Nominations to Division Executive Committees

The Board adopted changes in bylaws and in rules of procedure, which will give Local Sections a direct voice each year in nominating candidates for incoming members of Technical Division Executive Committees and incoming members of the committees under the Committee on Conditions of Practice.



Incoming Board of Direction is photographed at ASCE Headquarters during Annual Convention week. In front row (usual order) are William N. Carey, Executive Secretary; Mason Lockwood, Vice-President Zone IV; Edmund Friedman, Vice-President, Zone II; Walter L. Huber, Past-President; Daniel V. Terrell, President; G. Brooks Earnest, Vice-President, Zone III; Enoch R. Needles, Vice-President, Zone I; and Charles E. Trout, Treasurer. Second row shows Samuel B. Morris, Director, District 11; Thomas C. Shedd, Director, District 8; Oliver W. Hartwell, Director, District 4; Ernest W. Carlton, Director, District 14; William S. La Londe, Director District 1; Charles B. Molineaux, Director, District 1; A. A. K. Booth, Director, District 3; Raymond F. Dawson, Director, District 15; and Walter D. Binger, Director, District 1. In third row are George Washington McAlpin, Director, District 6; Lloyd D. Knapp, Director, District 7; Warren W. Parks, Director, District 9; Frank A. Marston, Director, District 2; Mercel J. Shelton, Director, District 11; Glenn W. Holcomb, Director, District 12; Carl G. Paulsen, Director, District 5; and James A. Higgs, Director, District 10.

Redistricting Studied

The Board of Direction considered the report of the Committee on Districts and Zones, which it received at its June 1953 meeting (July issue, page 73). The Board voted not to take action at this time on the subject of redistricting, but to refer the question again to the Committee on Districts and Zones for report at the June 1954 meeting of the Board of Direction. The Board also voted to instruct the Committee on Districts and Zones to consider the proposal for zonal boundaries on an area basis, as adopted by the Board of Direction at its June 1953 meeting, and in its June 1954 report to advise the Board of the practicability of redistricting within the zonal boundaries proposed by the Committee at the June 1953 meeting of the Board of Direction.

Study of Technical Division Structure

The Board approved the following recommendations contained in a progress report made by a Task Committee of the Executive Committee of the Board appointed in 1951 for the study of Technical Division structure:

(*a*) "National Conventions of the Society should place more emphasis on the general aspects of civil engineering such as the administrative and executive problems involved in planning and building large engineering works."

(*b*) "A policy should be established relative to financing joint conferences between ASCE Technical Divisions and bodies outside ASCE. In general such conferences should be self-supporting. In these cases where an ASCE Division is in charge of arranging for the conferences, ASCE should pay the cost of advertising, printing and mailing notices, registration and Society representation. In those cases where ASCE appears essentially as a co-sponsor on an equal basis with other groups a definite policy relative to publications should be established as a first step in planning such a conference."

(*c*) "The growing pattern of Conventions of District Councils and Regional Conferences should be given every encouragement. This series of conventions will provide facility for Divisions to present papers of general local interest as well as for papers of concern in conditions of practice. This principle could be applied to Local Sections when size and geography are appropriate."

(d) ". . . that the Meetings Committee be requested to study the advisability of eliminating one of the three National Conventions now held each year and in place of this meeting encourage more conventions of the District Councils and of Regional Conferences."

New Engineering Societies Building Site Studied

Proposals looking to the construction of a new Engineering Societies Building in New York or elsewhere, again were considered. A progress report indicated that U.E.T. has at least four sites under active consideration: New York City, Chicago, Pittsburgh, and Washington, D.C. The Board of Direction authorized its Executive Committee to act for it in this matter, except that final authority to commit the Society will rest with the Board.

Memorandum on Unionization to Be Circulated

Following review by the Committee on Employment Conditions and the Board of Direction, of a memorandum dated August 3, 1953, by Secretary Carey and Assistant Secretary Chandler, the Board ordered the memorandum to be circulated to Local Sections and Student Chapters. The subject treated is "Engineers, Unionization and the Tax Status of ASCE."

1954 Budget Adopted

The Committee on Budgets recommended and the Board of Direction adopted a budget for fiscal year 1954 in the amount of $1,085,017 for expenditures against an estimated $1,060,650 income. This anticipates a deficit of $24,367 for the year. This deficit, if it occurs, must be met from reserves. It was pointed out that this year is the first time ASCE has had a million-dollar budget.

Members Register for Automatic Mailing

In the early planning phases of the new procedure for issuing Proceedings Separates, it was estimated that 17,000 members would register a Technical Division preference for the routine receipt of free technical papers. A check count of returns on October 16 yields the following information on registration of the membership in the Divisions.

Division	Members	Percentage
Air Transport	227	1.2
City Planning	615	3.3
Construction	3,785	20.6
Eng.-Mechanics	409	2.2
Highway	1,915	10.4
Hydraulics	1,420	7.7
Irrigation	680	3.7
Power	408	2.2
Sanitary	1,750	9.5
Soil Mechanics	1,301	7.1
Structural	5,122	27.8
Surveying & Mapping	550	3.1
Waterways	228	1.2
Total	18,410	100.0

William E. Wrather Wins John Fritz Medal

William E. Wrather, past-president of the American Institute of Mining and Metallurgical Engineers and director of the U. S. Geological Survey, has been awarded the John Fritz Medal for 1954 by unanimous vote of a sixteen-man board representing the four Founder Societies. Established in 1902 by professional associates and friends of the late John Fritz, Hon. M. ASCE, engineer and industrialist, to honor him on his eightieth birthday, the medal is given annually for notable scientific or industrial achievement.

Dr. Wrather is cited as "A geologist of worldwide experience and fame; an outstanding scientist and historian; a wise leader distinguished for his service to the nation." Presentation of the medal will probably be made at a dinner to be held in New York sometime in December.

ASCE MEMBERSHIP AS OF OCTOBER 9, 1953

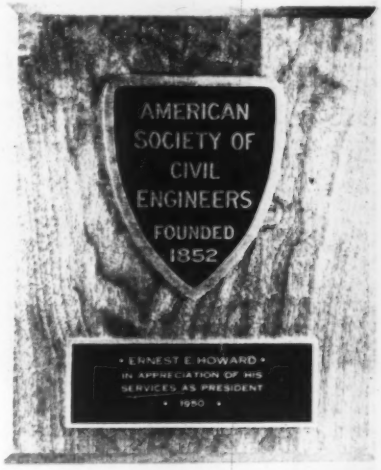
Members	8,457
Associate Members	10,715
Junior Members	17,054
Affiliates	70
Honorary Members	43
Total	36,337
(October 9, 1952)	35,099

Plaques of Appreciation Awarded ASCE Past-Presidents

Eight Past-Presidents of ASCE were honored in a special ceremony held during the recent Annual Convention week with plaques of appreciation for their services to the Society. President Walter L. Huber presented the plaques to the following: John P. Hogan, of New York, President in 1940; Ezra B. Whitman, of Baltimore, 1943; Malcolm Pirnie, of New York, 1944, Wesley W. Horner, of St. Louis, 1946; Richard E. Dougherty, of New York, 1948; Gail A. Hathaway, of Washington, D.C., 1951; and Carlton S. Proctor, of New York, 1952. Mr. Huber then received a plaque himself in recognition of the year as President he was just completing from Past-President Carlton S. Proctor.

Two Past-Presidents, who were prevented by illness from attending the ceremonies, will receive their plaques in their home cities later. They are John C. Stevens, of Portland, Oreg., President in 1945, and Edgar M. Hastings, of Richmond, Va., President in 1947.

Typical of the citations accompanying the awards was that prepared for Ernest E. Howard, of Kansas City, Mo., President in 1950, who died shortly before the Convention. His citation reads, "Mr. Howard, internationally renowned consulting engineer and specialist in bridge design, has been responsible for many notable projects in the United States and foreign countries and for important military construction in World War II. He has ably served the profession and the public as consultant to the Commission on Renovation of the White House; as active member of the International Association for Bridge and Structural Engineering and other groups devoted to engineering advancement on an international scale; and as one of the founders and, for many years, chairman of the Board of Trustees of the University of Kansas City. Mr. Howard's innumerable services to ASCE include terms as Director, Vice-President, and President." Mr. Howard's plaque was presented to ASCE Vice-President Enoch R. Needles, member of Mr. Howard's consulting firm, in behalf of his family.



Past-Presidents' plaques, one of which is shown here, consist of solid bronze reproductions of the ASCE shield mounted on solid walnut plaque, 12 by 15 by $\frac{3}{4}$ in. thick with beveled edges. The solid bronze nameplate, with raised letters and raised border filled and fired with royal blue French jeweler's enamel, also carries the inscription, "in appreciation of his services as President."

ASCE Past-Presidents honored with plaques of appreciation in special ceremonies held during recent Annual Convention are photographed with incoming ASCE President Daniel V. Terrell. Reading left to right are Past-Presidents Ezra B. Whitman, Wesley W. Horner, and Malcolm Pirnie; retiring President Walter L. Huber; Past-President Richard E. Dougherty; incoming President Daniel V. Terrell; and Past-Presidents Carlton S. Proctor, John P. Hogan, and Gail A. Hathaway.

FROM THE NATION'S CAPITAL

JOSEPH H. EHLERS, M. ASCE — Field Representative ASCE

Technical Assistance Program Being Reshaped

A reshaping of the Technical Assistance programs of the United States, long overdue, is in the making. The specific plans have not yet been formulated but press conferences and speeches of top officials give clues to possible developments. Mention has frequently been made of the many doubts concerning the effectiveness of the so-called Point IV Program which was designed to give the underdeveloped nations the benefit of modern American technology.

Even before the Point IV legislation was finally enacted in 1950, the President of the United States in person addressed an ASCE Convention on the proposal, saying that we would undertake a "bold, new program for making the benefits of our scientific advances and industrial progress available for the improvement and growth of underdeveloped areas." Other high officials said that "the judicious application of technical knowledge coupled with investment can bring about, gradually at first and then with snowballing momentum, a revolutionary improvement in the material and social well-being of the world's peoples." We were assured that the program's success would depend on engineers and other professional specialists; that it would lean heavily on private United States engineering and contracting firms. Now after several years of operation the program seems to be highly controversial. Engineers have been called on less than was anticipated. The program has many ardent supporters while many skeptics refer to it as a world-wide WPA.

There is no question but that the initiation of competent economic, technical and health surveys; the provision of expert missions; the establishment of research centers; the exchange of teachers and students offer great possibilities. The program cannot be attacked for its fundamental objectives. Who would want to argue against virtue and the will to do good toward mankind?

A basic fault is, perhaps, that its resources are scattered over too wide an area, that age-old, possibly insolvable, problems are tackled without a feasible overall plan. The desperateness of the problems encountered in some areas tends to turn the effort toward immediate relief of long-existing human suffering rather than toward material developments which might provide a long-range solution. That has given the program a WPA slant and tended to emphasize an immediate increase in food supply as an objective rather than long-range developments that might enable the area to enter effectively into world trade. It quite possibly leads to putting the program under the leadership of agriculturists who had been active in the WPA program rather than under engineering executives. The program is based, or at least has been rationalized, on the theory that undernourished peoples might fall into the Soviet orbit. However, the relation between the choice of a political system and hunger or lack of education is quite obscure; more often than not Communism is taken up by those who have already emerged from a previous condition of starvation and lack of education.

Point IV Program Not Essentially New

The naming of the program "Point IV," putting it forth as a newly conceived plan, misled people into believing that a brand new solution was being offered to age-old problems—newly invented magic from the West.

Nowhere has there been a more successful "Point IV type" program, vast in scale over a long period of time, than in China. Great universities were built and staffed by American missions, new agricultural techniques were devised, great modern hospitals developed, reclamation and highway development aided by American technicians, thousands of capable technicians trained in Chinese universities by American teachers, national development aided by extensive participation of private foreign investors and American companies. After all this successful effort, why did China not stave off Communism? The Communist movement did not originate with the underfed peasants of Shantung but rather with better educated and better fed peoples in the south who eventually trekked to the north.

The difficulty of evaluating the scattered TCA projects has been a cause of the differences of opinion regarding their worth. Statistics are lacking in underdeveloped countries and apparently little effort is being made to evaluate the results in dollars and cents or in any other system of physical measurement. Also there seems to be insufficient follow-up after developing a pilot project to determine whether it actually served to spark similar developments over an expanded area.

Economic Aid Consolidated

Reorganization Plan No. 7 established a Foreign Operations Administration, placing all economic-aid programs under one roof, with Harold Stassen as director. The Point IV Program had originally been inappropriately placed in the State Department—an operating program far removed from the foreign-policy-making functions of that department. The MSA program was not well geared to this technical assistance program, but later an attempt was made to remedy the defect by a division of work by countries. For example, MSA was designated to handle all projects in the Philippines and Indo-China, while the Technical Cooperation Administration handled assistance of all sorts in Burma and India.

The organization chart recently issued shows the headquarters work divided into planning, management, and various staff functions, centering in the Director; field operations for all programs in a unified regional grouping under a single director for each of four major areas of the world, reporting to a Deputy Director for Operations.

Although the appropriations for the current fiscal year have been reduced, they are still of sizable proportions. For Point-IV-type operations about $34 million was appropriated for the Near East and Africa; $51 million for Asia and the Pacific; $22 million for Latin America—a total of nearly $100 million, not including $9½ million for multilateral technical assistance through the United Nations and similar groups. These amounts are exclusive of other special economic assistance of $147 million for the Near East and Africa, and $95 million for India and Pakistan which is not classified as "technical assistance." The sum of $57 million is available for the administrative expenses of the entire agency, a reduction from the amount requested. This necessitates a reduction of 20 percent in employment. There is also a specific requirement that the number of employees receiving $12,000 or more be reduced by one-third from the June 30 figure.

There are indications that the Economic and Technical Assistance Programs will be more closely geared to supplement one another. In technical assistance work much greater emphasis will be placed on contracts with private groups such as missionary societies and universities to carry out specific tasks. Many of these private groups have been in the foreign assistance field for decades. This step may increase the people-to-people relationship, provided military aid is kept quite distinct and apart. It is hoped that there will be improved top-level planning between high-ranking American technical experts and foreign governments so that the work contracted through private organizations may be keyed into an overall plan rather than constitute a group of isolated pilot projects that might readily be forgotten.

In the future many such groups will undoubtedly continue or even expand the activities begun under such contracts by supplementing the government funds with privately raised funds. American industry could become an important contributor when it becomes convinced that the projects will stimulate private investment or encourage development that will enable these areas to play a more important part in our foreign trade.

New directives which will re-orient this program to overall economic aid and place it on a more businesslike basis may soon be forthcoming.

Washington, D.C.
October 20, 1953

Returns from Questionnaire on Employment Conditions, 1953, Summarized

As instructed by the Board of Direction, a "Questionnaire on Employment Conditions, 1953," as developed by the Society's Committee on Employment Conditions, was sent to all members of the Society resident in the continental United States, Alaska, Hawaii, Puerto Rico, and the Canal Zone. Those with APO and foreign addresses were not included. On that basis, 32,221 questionnaires were mailed on or before August 12, 1953. There follows an IBM analysis of the 17,203 returns received by October 1. A summarization of the IBM analysis is shown factually, without any attempt at interpretation of the results. These are the data, the determined facts, now made available to the Committee on Employment Conditions and the Board of Direction for consideration in its current considerations of this important subject.

The response reached the surprising total of a little over 53 percent. Breaking the returns down into grades of membership, it is found that the percentage in each grade coincides within a few percent in each case with the corresponding breakdown of the Society's membership into grades. The results of the questionnaire would appear to reflect very closely the collective attitude of the entire membership.

Question 1

Membership grades of respondents:

Junior Members	7,098
Associate Members	5,345
Members	4,648
Affiliates	17
No indication	95
Total	17,203

Question 2

Age of respondents:

20–30	5,419
31–40	3,911
41–50	3,051
51–60	2,298
61–70	1,881
71 or over	584
No indication	59
Total	17,203

Question 3

Employment status:

Employer	2,514
Supervisor	6,430
Non-supervisory employee	7,633
No indication	626
Total	17,203

Question 4

Location of respondents by states:

Alabama	197	Montana	88
Alaska	66	Nebraska	160
Arizona	110	Nevada	39
Arkansas	110	New Hampshire	41
California	2,646	New Jersey	579
Canal Zone	0	New Mexico	106
Colorado	309	New York	1,468
Connecticut	226	N. Carolina	150
Delaware	103	N. Dakota	55
D.C.	274	Ohio	684
Florida	274	Oklahoma	189
Georgia	253	Oregon	275
Hawaii	68	Pennsylvania	999
Idaho	80	Puerto Rico	42
Illinois	911	Rhode Island	53
Indiana	238	S. Carolina	136
Iowa	172	S. Dakota	46
Kansas	240	Tennessee	378
Kentucky	194	Texas	934
Louisiana	251	Utah	113
Maine	93	Vermont	17
Maryland	490	Virginia	510
Massachusetts	456	Washington	573
Michigan	445	W. Virginia	101
Minnesota	214	Wisconsin	278
Mississippi	110	Wyoming	42
Missouri	552	No indication	65
		Total	17,203

Question 5

Those in each grade of membership who reported being registered, either as engineers or engineers-in-training:

Junior Members	4,674
Associate Members	4,204
Members	4,113
Affiliates	12
Total	13,003

Question 6

Character of service:

Government service	6,119
Private engineering practice	4,621
Industry	5,222
Education	824
No indication	417
Total	17,203

Question 7

Job classifications reported under ASCE grades (as defined in CIVIL ENGINEERING, July 1953, p. 54):

I	299	VI	1,424
II	1,560	VII	1,388
III	2,786	VIII	1,352
IV	2,204	IX	853
V	1,741		
		Total	13,607

Question 8

Those reporting as opposed, and those not opposed to collective bargaining, broken down according to grades of membership:

Membership	Opposed	Not Opposed
Junior Members	3,945	3,080
Associate Members	3,415	1,871
Members	3,328	1,234
Affiliates	6	10
Totals	10,694	6,295

Reasons reported for opposing collective bargaining are as follows:

Membership	Incompatibility with "Professional Status"	Other Reasons
Junior Members	3,511	826
Associate Members	3,119	517
Members	3,139	359
Affiliates	6	1
Totals	9,775	1,703

Broken down according to age groups, those reporting as opposed to collective bargaining and those not opposed:

Age Group	Opposed	Not Opposed
20–30	2,978	2,388
31–40	2,327	1,541
41–50	1,979	1,039
51–60	1,605	657
61–70	1,373	479
71 or over	448	105
Totals	10,710	6,209

Reasons reported for opposing are as follows:

Age Group	Incompatibility with "Professional Status"	Other Reasons
20–30	2,640	634
31–40	2,083	446
41–50	1,847	254
51–60	1,509	178
61–70	1,289	146
71 or over	422	45
Totals	9,790	1,703

Question 9

Those reporting belief that collective bargaining is, or would be, advantageous to them and those who do not believe so, by grades of membership:

Membership	Those Who Do	Those Who Do Not
Junior Members	2,290	4,720
Associate Members	1,204	4,018
Members	681	3,817
Affiliates	8	8
Totals	4,183	12,563

Those who believe collective bargaining to be advantageous expressed the following preference as to representation:

Membership	Professional Employee Bargaining Group	Craft or Labor Union
Junior Members	2,126	98
Associate Members	1,110	46
Members	624	23
Affiliates	7	1
Totals	3,867	168

Those reporting belief that collective bargaining is, or would be, advantageous

to them and those who do not believe so, by age groups:

Age Group	Those Who Do	Those Who Do Not
20–30	1,768	3,583
31–40	1,088	2,765
41–50	601	2,385
51–60	417	1,818
61–70	275	1,549
71 or over	52	479
Totals	4,201	12,579

Those who believe collective bargaining to be advantageous expressed the following preference as to representation:

Age Group	Professional Employee Bargaining Group	Craft or Labor Union
20–30	1,650	71
31–40	992	52
41–50	557	19
51–60	389	14
61–70	250	12
71 or over	43	1
Totals	3,881	169

Question 10

Those reporting as members of established collective bargaining groups:

By age groups:

20–30	256
31–40	140
41–50	98
51–60	73
61–70	46
71 or over	11
Total	624

By states:

Alabama	3	Montana	5
Alaska	3	Nebraska	1
Arizona	3	Nevada	3
Arkansas	4	New Hampshire	0
California	222	New Jersey	6
Canal Zone	0	New Mexico	2
Colorado	7	New York	49
Connecticut	11	North Carolina	4
Delaware	0	North Dakota	1
Dist. of Columbia	11	Ohio	8
Florida	0	Oklahoma	4
Georgia	8	Oregon	15
Hawaii	9	Pennsylvania	12
Idaho	4	Puerto Rico	0
Illinois	21	Rhode Island	2
Indiana	15	South Carolina	1
Iowa	4	South Dakota	0
Kansas	2	Tennessee	51
Kentucky	6	Texas	8
Louisiana	0	Utah	3
Maine	5	Vermont	0
Maryland	8	Virginia	3
Massachusetts	8	Washington	62
Michigan	9	West Virginia	1
Minnesota	4	Wisconsin	6
Mississippi	4	Wyoming	0
Missouri	3	No indication	4
		Total	625

The American Society of Mechanical Engineers has initiated circulation of a similar questionnaire to its membership. The other constituent societies of Engineers Joint Council are expected to follow suit to obtain similar information for the remainder of the profession.

Biography of Honorary Member Billings in Brazil Available

The history of engineering is studded with the accomplishments of dynamic men of great vision. Such a man was A. W. K. Billings, Hon. M. ASCE, whose biography, *Billings and Water Power in Brazil*, has now been published by the author, Adolph J. Ackerman, M. ASCE, with ASCE as co-publisher. His is the story of an engineering career in a foreign land, of twentieth century pioneering. The biography relates the hazards and obstacles of the early years, which were overcome, and his ultimate achievement that won the warm friendship of a grateful nation.

Mr. Ackerman, a consulting hydroelectric engineer of Madison, Wis., was Mr. Billings' successor on the power development program of Brazil and contributed greatly to the successful completion of Billings' plan.

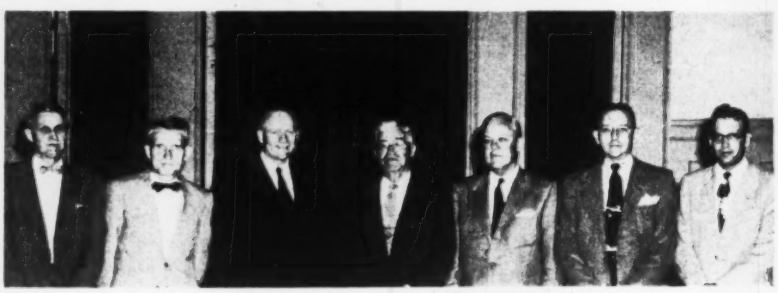
Copies of *Billings and Water Power in Brazil* may be ordered from ASCE, 33 West 39th Street, New York 18, N. Y., at $7 a copy, prepaid for shipment in the United States. A 10 percent discount is available on lots of ten or more. A coupon has been provided in the advertising section (page 99) to facilitate ordering the volume.

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the tenth of the month preceding date of publication.)

O. W. Irwin, president of the Rail Steel Bar Association and former manager of sales for the Carnegie-Illinois Steel Corp., addressed the **Akron Section's** first meeting of the fall season, on September 24, on the subject of "Conservation of Steel by Design." Mr. Irwin is seeking to persuade various building departments and trade associations to raise the allowable design stresses of reinforcing steel to values he feels are more realistic in view of present-day techniques.

"More progress has been made in the use of timber construction in the past thirty years than was made in the previous 315 years—since the first shipment of forest products was made from the Colonies 345 years ago," Ralph H. Gloss, Washington, D.C., engineer, told members of the **Alabama Section** in a talk given at their fall meeting at Montgomery on September 25. Mr. Gloss, who is secretary of the Timber Engineering Co., research affiliate of the National Lumber Manufacturers Association, attributed the advances of the past thirty years to the "same calculated study and research" that have brought steel and concrete to the fore rather than to "any startling discovery."



University of Kentucky Student Chapter sponsors general assembly of engineering students on October 1 to honor ASCE President-elect D. V. Terrell, dean of the College of Engineering. Members of ASCE taking part in the program are (left to right) A. L. Chambers, Faculty Adviser for the Chapter; L. E. Gregg, president of the Kentucky Section; Warren W. Parks, ASCE Director for District 9; Dean Terrell; J. S. Watkins, Section Contact Member for the Chapter; R. E. Shaver, head of the department of civil engineering; and G. E. Alderdice, Student Chapter president.

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The Hon. Frank B. Heintzleman, governor of Alaska, and Gerald Fitz Gerald, chief of the Topographic Division of the U.S. Geological Survey, were guest speakers at the banquet concluding the **Alaska Section's** second annual meeting, held in Juneau on October 3. The governor spoke on the role of the Section in the development of Alaska, and Mr. Fitz Gerald described the history of the mapping of the territory from earliest reconnaissances to the present. During the afternoon business meeting, Glenn C. Holcomb, ASCE Director for District 12, Corvallis, Oreg., outlined some of the problems facing the Society and discussed solutions that have been advanced.

Past-presidents of the **Buffalo Section** were honored at the Section's luncheon meeting on September 15. Present to receive the thanks of the Section and to hear words of praise from current president, Frederick W. Crane, were Robert T. Moore, A. Stuart Collins, Harry M. Huy, Louis S. Bernstein, Martin H. Brennan, Norman M. Herthe, William T. Huber, Elwin G. Speyer, George F. Unger, Col. William Kelly, and Lynn L. Davis.

In the principal talk at the September meeting of the **Duluth Section** Charles Britzius, of the Twin City Testing Laboratory, discussed the function of the modern testing laboratory, citing the soils grouping of the U.S. Bureau of Soils and the Corps of Engineers as the foundation of test reporting.

Junior Members of the **Georgia Section** provided the program for the October 2 dinner meeting. Led by Lewis E. Parker, junior highway engineer, they described the Georgia State Highway Department's training program for engineering graduates. Participants were Lewis E. Parker, John W. Caldwell, Glenn S. Hinshaw, W. D. McKoy, W. C. Anderson, James B. Brawner, Jr., Lee R. Potter, Jr., and W. E. Fraser. The September meeting of the Section's **Central Savannah River Subsection** consisted of a tour of the Urquhart Power Station of the South Carolina Electric and Gas Co., followed by a dinner. Robert Shade of Gilbert Associates, designers of the project, and N. D. Urquhart, chief construction engineer, showed construction slides of the station and answered questions about it during the dinner program.

City traffic engineering, with specific reference to the Salt Lake City area, was the topic of discussion at the September 17 meeting of the **Intermountain Section.** The principal speaker was S. S. Taylor, city traffic engineer.

A stepped-up meeting program is planned by the **Kansas Section,** with two get-togethers a month—one in Topeka, Lawrence, or Manhattan, and one elsewhere in the state, the place to be determined by the number of paid-up members in the locality. At the September 18 dinner meeting, members saw a film produced by the Army Corps of Engineers and entitled "Big Pipe Maneuver."

At its September meeting the **Kansas City Section** paid tribute to ASCE Past-President Ernest E. Howard, "distinguished and beloved member," who died suddenly on August 19. The technical program consisted of a talk by George Clay, secretary of Trans World Airlines, on Kansas City's new Industrial Airport, and TWA's overall plans for development of air travel facilities in the area.

The **Metropolitan Section** adds to the growing list of Section publications with issuance this month of the first number of *Metropolitan Section Newsletter.* Long in the planning, the four-page, coated sheet in 9 by 12-in. format will endeavor to keep Section members abreast of ASCE developments at local level. It will be issued eight times a year by a Publications Committee headed by Bob Lockwood.

Long-range plans for conservation and reclamation in Holland were discussed at the September 11 luncheon meeting of the **Vicksburg Branch** of the **Mid-South Section,** held at the Waterways Experiment Station. The principal speaker was H. J. Schoemaker, deputy director of the Hydraulics Laboratory at Delft, Holland, who has been in this country attending the International Hydraulics Conference in Minneapolis.

New **Montana Section** officers, elected at the annual meeting in Helena on September 19, are George J. Hoge, president; O. C. Reedy, Harold L. Eagle, and Donald R. Cubbage, vice-presidents; and Lucy W. Pettapiece, secretary-treasurer. Mrs. Pettapiece is one of the very few women engineers ever to hold Section office.

Inspection of the Naval Ammunition Depot at Hastings, Nebr., with special attention to precast concrete construction under way there, was a main feature of the **Nebraska Section's** annual "out-state" meeting held on September 26. With several units of the inert storage type under way, the group of 59 making the trip were able to follow through the entire construction process in one tour. At the dinner meeting that followed, W. H. Thurman, engineer for the Concrete Casting Co., of Kansas City, spoke on "The Advantages of Precast Construction."

Problems involved in construction of the Black Dog Power Plant, located on the Minnesota River south of Minneapolis, were discussed at the **Northwestern Section's** first meeting of the fall season—in St. Paul on October 5—by Hibbert Hill, chief engineer of the Northern States Power Co. The plant is one of the largest in the area.

The September meeting of the **Central Pennsylvania Subsection** of the **Philadelphia Section,** held in Harrisburg, was devoted to study of problems involved in treatment and disposal of sewage and industrial waste in the state. Speakers were C. H. Young and F. B. Milligan, division engineers for the Pennsylvania Department of Health; A. F. Jones, directing engineer for the General State Authority; and C. M. Pepperman, chief designer in the Sanitary Division of Gannett, Fleming, Corddry and Carpenter, Inc., of Harrisburg.

The recently formed **Central Valley Subsection** of the **Sacramento Section** was activated at a special meeting, held at Kentucky House on the grounds of the Calaveras Cement Company's plant near San Andreas, Calif., on September 19. A tour of the plant, followed by dinner at Kentucky House and talk by Ted Stivers, chief engineer of the South San Joaquin Irrigation District, constituted the program. Mr. Stivers' subject was the Tri-Dam Project contemplated for the North Fork of the Stanislaus River. Charter officers of the Subsection, installed during the meeting, are John G. Meyer, president; Felix A. Wallace, vice-president; Frank Lucas, secretary; and Harry M. Moses, treasurer. All are located at Stockton.

A panel of speakers from the Seattle City Light talked and showed slides on the utility's Skagit River development at the **Seattle Section's** September dinner meeting. They were C. W. Cutler, Eric C.

Some of twenty-three past-presidents of Central Illinois Section receiving Certificates of Appreciation at Section's September meeting, held at Allerton Park, Ill., are (left to right): W. B. Worsham, H. H. Jordan, N. H. Gundrum, J. G. Clark, W. L. Collins, W. C. Huntington, W. H. Wisely, C. M. Hathaway, R. P. Hoelscher, Director-elect T. C. Shedd, W. D. Gerber, H. E. Babbitt, and W. M. Lansford. Featured speaker at the dinner meeting was W. H. McPherson, professor of economics at the University of Illinois, who gave a provocative talk on "Major Industrial Relation Problems."

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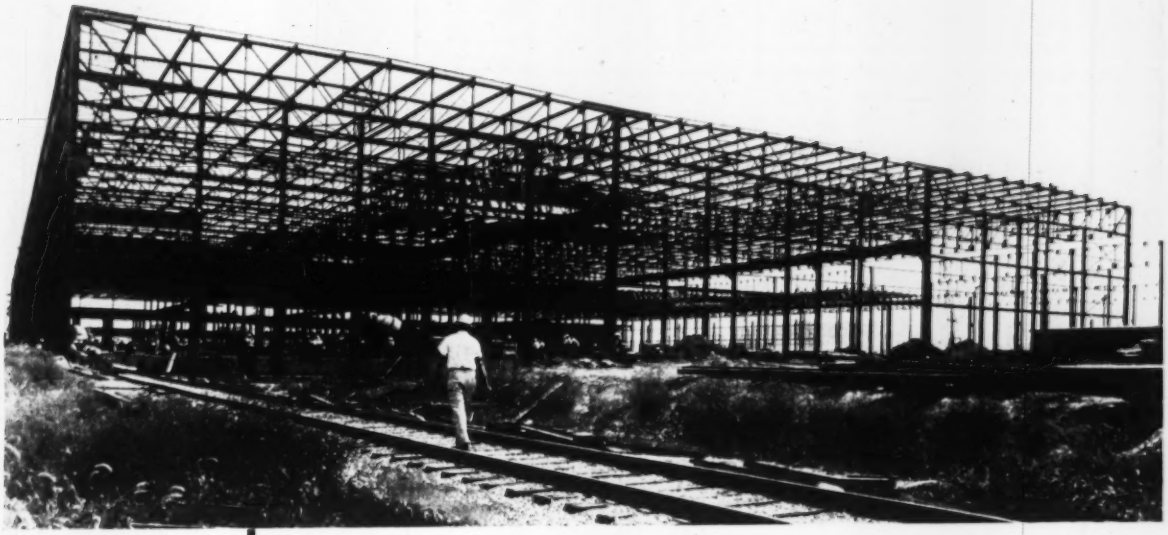

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Highway Engineers Honored at Texas Section Meeting

Presentation of Awards of Honor to ASCE Honorary Member Thomas H. MacDonald, retired head of the Public Roads Administration, and Gibb Gilchrist, chancellor of the Texas A & M System, for their contributions to highway development in the United States is important feature of Texas Section's fall meeting, held in San Antonio on October 15 and 16. Shown here, in usual order, are Mr. MacDonald, D. K. Martin, Chancellor Gilchrist, ASCE Vice-President Mason G. Lockwood, and Robert J. Potts. In addition, the Section presented certificates for service rendered the Section by twenty-one past-presidents. Highlighting the technical program were papers presented by State Highway Engineer D. C. Greer; G. Donald Kennedy, executive vice-president of the Portland Cement Association, and Mr. MacDonald. A panel, consisting of R. M. Shipman, Oren Edrington, and Drahn Jones, city engineer of Waco, Tex., discussed engineering problems involved in the Waco tornado Disaster. New officers installed at the close of the meeting are Randle Alexander, of Austin, president; Trent Campbell, of San Antonio, vice-president; and James R. Sims, of Houston, secretary-treasurer. Meeting attendance was 392.

Brundage, and C. R. Hoidal. Hanford Thayer was program chairman.

Tacoma Section members invited local members of the AIEE and the Tacoma Engineers Club to attend their first regular meeting of the new season, held on September 8. The large joint attendance heard Franklin Matthias, assistant project manager for the Kittimat Project of the Aluminum Company of Canada, speak on the Kittimat Project. Colonel Matthias used slides and a colored sound film, entitled "Prelude to Kittimat," to illustrate the program pronounced "one of the most interesting in many years."

New officers for the **Houston Branch** of the **Texas Section,** elected at the Branch's annual meeting on September 22, are N. P. Turner, president; R. A. Rait, vice-president; and Bramlette McClelland, secretary-treasurer. The **San Antonio Branch's** new officers are F. M. Davis, president; J. J. Koy, vice-president; and C. F. Braunig, Jr., secretary-treasurer.

Plans for organizing Subsections in Richmond and Roanoke, Va., were approved by the **Virginia Section** at its annual meeting held in Roanoke, Va., on September 25. The speaker of the evening was E. L. Chandler, Assistant Secretary of ASCE, New York, who discussed collective bargaining, which he termed "one of the chief problems in the profession today." Mr. Chandler told the group that the Taft-Hartley Act defined professional employees for the first time and gave them the right to refuse union membership.

Scheduled ASCE Conventions

ATLANTA CONVENTION
Atlanta, Ga.
Hotel Biltmore
February 15–19, 1954

ATLANTIC CITY CONVENTION
Atlantic City, N.J.
Chalfonte-Haddon Hall
June 14–19, 1954

NEW YORK CONVENTION
Hotel Statler
October 18–22
1954

Coming Events

Akron—Dinner meeting at the Akron Liedertafel, November 19, at 6:30 p.m., will be addressed by Dr. George E. Barnes of Case Institute of Technology.

Central Ohio—Joint dinner meeting with member societies of the Columbus Technical Council scheduled for the Seneca Hotel, Columbus, November 12, with Charles F. Kettering, Hon. M. ASCE, as speaker.

Cleveland—Dinner meeting at the Cleveland Engineering Society on November 20 at 6:30 p.m.

Kansas—Meeting at Lawrence on November 20. Meeting at Salina on November 27.

Los Angeles—Soil Mechanics Group will meet at the Clark Hotel, 426 South Hill St., on November 18, 6:30 p.m. Sanitary Group will meet on December 2, 6:30 p.m. Junior Forum sponsors noon luncheons every Friday at the Engineers Club. Call Chuck Gorham, Michigan 4211, Ext. 456, for reservations.

Maine—Annual dinner meeting of the New Hampshire Branch at the Millville Inn, Concord, N.H., November 18 at 6:30 p.m.

Metropolitan—Meeting in the auditorium of the Engineering Societies Building, 33 West 39th St., New York, N.Y., on November 18, 7 p.m. The Junior Branch meets in the ASCE Board Room at the same address, December 9 at 7 p.m.

Oklahoma—Annual meeting at Norman, Okla., on November 28.

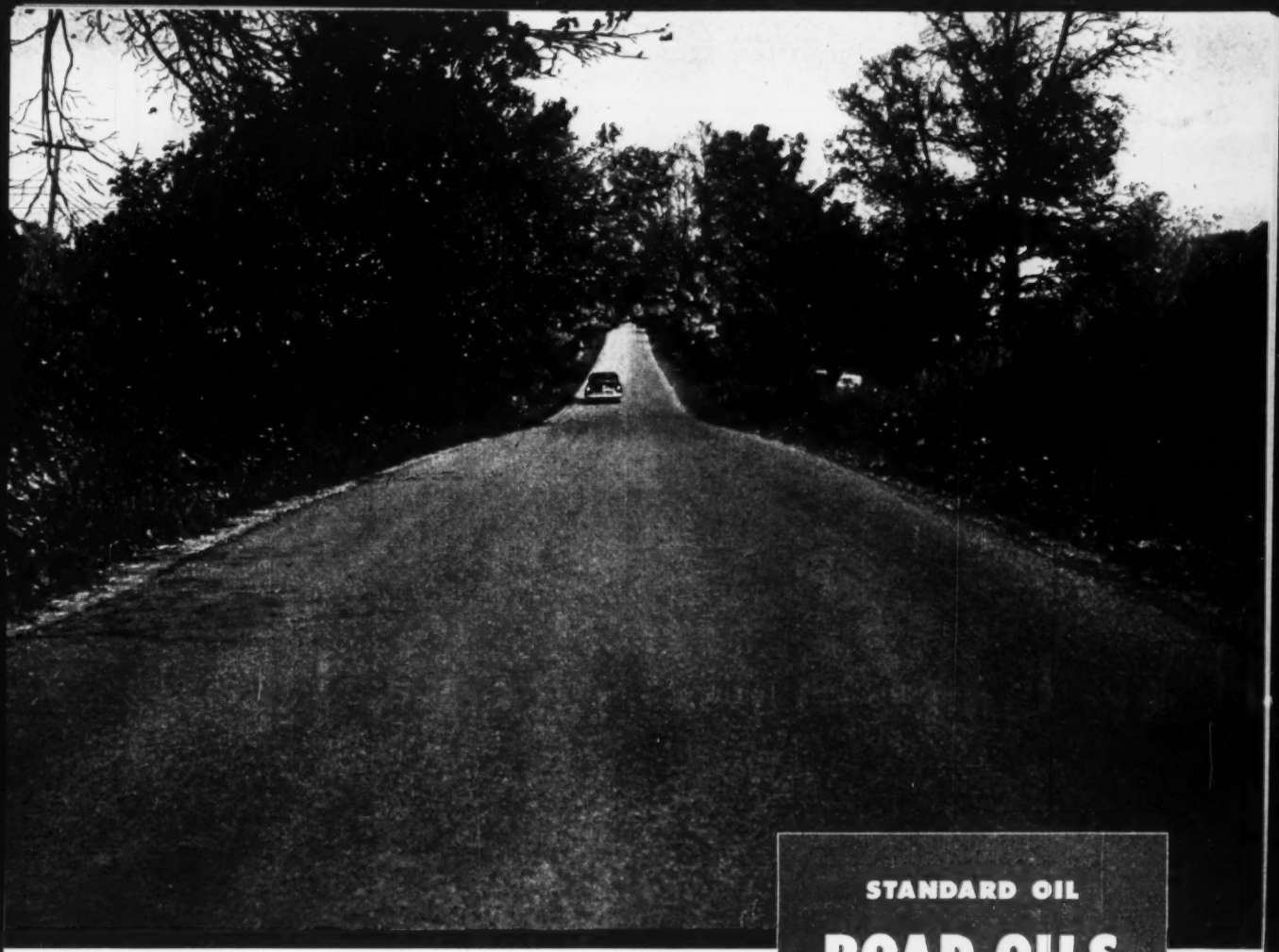
Philadelphia—Meeting at the Engineers Club on November 10. Junior Forum meeting at same address on November 24.

Providence—Meeting at the Providence Engineering Society on November 12.

Sacramento—Weekly luncheon meetings at the Elks Temple every Tuesday at 12 noon.

Tennessee Valley—Annual two-day fall meeting at the Whittle Springs Hotel, Knoxville, Tenn., November 13 and 14. Program will include business and technical sessions, luncheon, dinner with an address by ASCE President Daniel V. Terrell, square dance, and a Saturday morning inspection trip to the Kingston Steam Plant.

Virginia—Annual joint meeting with the Engineers Club of Hampton Roads at the Norfolk Yacht and Country Club, Norfolk, Va., November 17. Annual meeting of the Section at the Hotel Jefferson, Richmond, December 4 and 5.



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Road builders obtain greater economy and speed in their work through Standard Oil's service and supply set-up. From any of Standard's four great refineries located throughout the Midwest, road oils and asphalt can be delivered promptly to road-building jobs. Standard Oil Asphalt Representatives are situated throughout the Midwest to give "on-the-spot" service. You can reach one of these men by phoning your local Standard Oil office. Or write: Standard Oil Company (Indiana), 910 So. Michigan Ave., Chicago 80, Ill.

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NEWS BRIEFS . . .

Navy to Administer Construction Program in Spain

Details of the military construction program that the United States will have in Spain, following recent completion of an agreement with the Spanish government for the use of certain bases in exchange for military aid, have been announced by the Navy. Congress has appropriated funds for the $125,000,000 program, which will include the construction of new bases and the rehabilitation and modernization of existing bases. Though the facilities will include both Navy and Air Force installations, it has been agreed that the entire program will be administered by the Navy Bureau of Yards and Docks.

After reviewing the qualifications of a number of architect-engineer firms, a joint Navy-Air Force board has selected four for the joint venture. The firms are Shaw, Metz and Dolio, of Chicago; Metcalf and Eddy, of Boston; Frederic R. Harris, Inc., of New York; and Pereira and Luckman, of Los Angeles. This combination will soon establish offices in Madrid, where the master plans and designs will be prepared.

On the basis of information now available, it is expected that a United States construction firm, or combination of firms, will be selected to act as prime contractor under a cost-plus-fixed-fee contract. Wherever possible, the actual work will be performed by Spanish subcontractors, using native labor and materials. Construction firms, or combinations of firms, interested in serving as prime contractor are invited to submit an up-to-date brochure as soon as possible to the Chief of the Bureau of Yards and Docks, U.S. Navy, Washington 25, D.C.

For staffing of field activities, the Officer-in-Charge of Construction will have a civil service organization in several areas of Spain. Determination of the exact size and organization of these bodies has not yet been made. However, the Bureau of Yards and Docks is compiling a list of applicants for such employment, and interested persons should indicate their interest by letter to the Chief of the Bureau.

Two Presidents Dedicate Falcon Dam and Power Plant

Falcon Dam on the Rio Grande between Texas and Mexico was dedicated by President Eisenhower and President Cortines of Mexico in elaborate ceremonies on October 19. In their dedicatory speeches, both hailed the building of the international project as an example of successful cooperation between two nations and as a new bond of friendship and good will between the United States and Mexico.

President Eisenhower said, "More than a mute monument to the ingenuity of engineers, this Falcon Dam is living testimony to the understanding and the cooperation binding our two peoples." He praised the International Boundary and Water Commission, which is constructing the project, saying that in the sixty-five years of its existence it has "resolved problems that elsewhere in the world have flared into bitterness and hostility."

Located on the Rio Grande some 75 miles below Laredo, Tex., and Nuevo Laredo, Mexico, the dam is almost five miles long and backs up a vast lake not yet fully filled. Though primarily an irrigation dam, it will also provide electric power and flood control. The $47,000,000 cost of the project was borne by the two countries in proportion to the water they will take—58.6 percent for the United States and 41.4 percent for Mexico. The project is the first of the international storage structures provided by the Water Treaty of 1944 between the United States and Mexico. There was an article on Falcon Dam in the May 1951 issue.

Passage of water through Falcon Dam spillway is shown here. With capacity of 460,000 cfs, spillway is larger than that of Hoover Dam. It is expected that the dam will be completed by the end of November, and the powerhouse installations by July 1, 1954.

Second Tunnel Under Houston Channel Opened

A $10,000,000 tunnel under the Houston Ship Channel was opened in recent ceremonies, at which the governor of Texas and other officials spoke. The 4,110-ft-long tunnel, which connects the two bayshore industrial centers of Baytown and La Porte, is similar in construction to the 4,064-ft Washburn Tunnel located farther up the channel near Houston. Replacing five ferries at different points along the highly industrialized ship channel, the two tunnels were designed to speed up the flow of traffic between the north and south shores of the channel.

The Baytown-La Porte Tunnel, which has been under construction for two years, was built with funds supplied by four agencies—Harris County, in which the project is located, the Houston Navigation District, the Texas State Highway Department, and the federal government. It is a toll-free facility.

The New York firm of Parsons, Brinckerhoff, Hall & Macdonald was in charge of design and supervision of construction. Principal contractors on the project were Brown & Root, Inc., and the Farnsworth & Chambers Co., both of Houston. The latter firm handled the paving work, which included construction of a three-level traffic interchange located on the La Porte side of the tunnel.

Former Chief of Engineers Proposed for U.N. Post

Appointment of Lt. Gen. Raymond A. Wheeler, former chief of Army Engineers, to the key position as head of the United Nations Relief and Works Agency for Palestine Refugees, has been proposed by the United States, subject to confirmation by the Secretary-General of the U.N. Following his retirement as Chief of Engineers in 1949, General Wheeler served as engineering adviser to the International Bank for Reconstruction and Development. For the World Bank, he helped with an engineering survey of the Indus River system to save wasted waters for irrigation and settle disputes between India and Pakistan for control of the riverways.

The post, which involves improving living conditions for 800,000 displaced Arabs, carries with it the rank of an Assistant Secretary General and is considered one of the top administrative appointments in the United Nations.

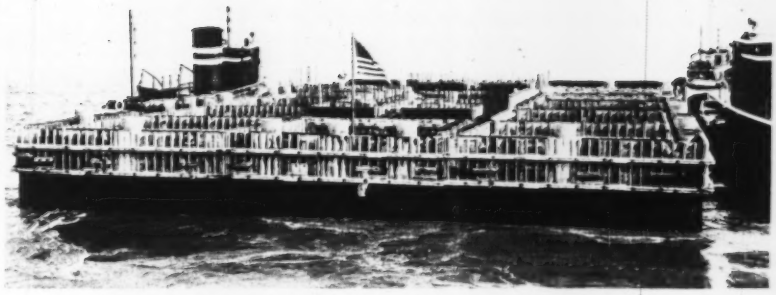
Westinghouse to Supply Power Plants for Japan

Three complete 75,000-kw thermal electric power plants, costing approximately $29,500,000, have been ordered from the Westinghouse Electric Company, Inc., by the Kyushu Electric Power Company, Inc., and the Kansai Electric Power Co., Inc., of Japan. First of their size ever exported from this country, the three high-efficiency units are part of a vast program now under way in Japan to expand the electric power facilities of the country. Equipped to burn either oil or low-quality pulverized coal, they will supplement hydroelectric plants currently used for power generation. The projects have been made possible through a recent $40,200,000 loan agreement between the World Bank and the Japan Development Bank, which is supplying funds to the Japanese firms for their expansion.

Philadelphia Firm Builds Power Plant in Sicily

Completion of construction of the Palermo Steam Power Plant in Sicily is announced by the Kuljian Corporation, Philadelphia engineering and construction firm in charge of the design and engineering work. The plant, which consists of three 30,000-kw units, plus outside fuel-handling facilities, intake and discharge channels, is owned by a public utility, "Societa Termo-Elettrica Siciliana." It was financed by the ECA as part of a program to speed the economic recovery of southern Italy and Sicily.

Caisson Is Floated to Thruway Bridge Site



One of eight watertight reinforced concrete caissons that will provide a buoyant-type base for the mid-river piers of the Thruway Bridge across the Hudson between South Nyack and Tarrytown is shown on a ten-mile tow trip downstream to the construction site. The eight caissons, or boxes, the largest of them half the size of a city block and weighing 21,000 tons, were built for Merritt-Chapman & Scott by the Corbetta Construction, Co., Inc., in a natural drydock on the west bank of the river near Haverstraw. The buoyant-type foundation, similar to that used for the substructure sections of New York City's new Pier 57, was designed by Emil H. Praeger, M. ASCE, chief engineer for Madigan-Hyland, consulting engineers on the Thruway project. Its use was specified because, at the construction site, solid rock is too far below the silty river bottom—230 to 300 ft—to be used for satisfactory pier support. The boxes will be filled with water to sink them into place, with the top of each box 2 ft below the surface. Steel pipe piles will be driven through wells in the caisson walls to bedrock to anchor the caissons permanently. After the 28,000 tons of steel superstructure for the main spans are placed, the water will be pumped from the caissons to provide the required buoyancy. The caissons will then support 67 percent of the dead load of the bridge. See article by Bertram D. Tallamy in this issue.

Third International Soil Mechanics Conference Is Widely Attended

More than 800 experts in soil mechanics from thirty different countries attended the Third International Conference on Soil Mechanics and Foundation Engineering, held at Zurich, Switzerland, August 14–27. About 50 were from the United States. The conference consisted of eight technical sessions, held at Zurich over a period of five days, followed by a four-day tour of Switzerland to visit earth and concrete dams under construction, mountain highway work, avalanche and landslide protection works, and other heavy construction.

Structures visited included the Marmorera earth dam, which is under construction, and the concrete dam at Oberaar, which is nearing completion. The reservoir above Oberaar Dam is formed by water from the Oberaar Glacier that flows down from the mountains into the valley across which the dam is built. The tour ended at Lausanne, where a farewell banquet was held.

Summaries of 154 papers were presented for study at the technical sessions. They covered theories, laboratory investigations, field investigations, building and dam foundations, pile foundations, highways and airport runways, earth pressures on retaining walls and excavations, and the stability of slopes. Two volumes of conference Proceedings, containing the 154 papers summarized for the technical sessions, were published in the spring of 1953. The numerous discussions presented at the conference will constitute a third volume of Proceedings, which will be distributed by the end of the year.

During the business meeting preceding the conference, Dr. Karl Terzaghi, Hon. M. ASCE, of the United States, was re-elected president, and A. Bannister, of Great Britain, was elected secretary. Five vice-presidents chosen represent the five continents. Terms of office will run until the Fourth Conference, which will be held in London in about five years.

As chairman of the executive committee of the U.S. National Council on Soil Mechanics and Foundation Engineering, A. E. Cummings, M. ASCE, represented the United States at the meetings of the international executive committee. Material for this item was taken from Mr. Cummings' report of the conference.

Sewerage and Drainage Program Developed for Greater Vancouver

An overall plan for providing sewerage and drainage facilities for the entire Greater Vancouver area, "at the lowest cost commensurate with adequate accomplishment," has been recommended to the Vancouver and Districts Joint Sewerage and Drainage Boards by a Board of Engineers authorized to make a survey of the sewerage and storm drainage situation. The Board of Engineers consisted of Charles G. Hyde, John Oliver, and A M Rawn, chairman.

For purposes of the survey the Greater Vancouver area was divided into three basic sections delineated by topographic, geographic, and economic considerations. These sections are the Burrard Peninsula Sewerage Section, the North Shore Sewerage Section, and the Richmond Sewerage Section. Each of the first two sections would have its own treatment plant, while sewerage from the Richmond Section would be conveyed to the Burrard Peninsula Section.

The program includes plans for high-rate primary treatment, standard-rate primary treatment, and discharge of crude sewage at selected sites, with provision made in site selection for the construction of treatment plants at some later date if water-use demands change. The board generally recommended separate collection systems for storm water and sanitary sewage. It was also of the opinion that general obligation bonds would be the fairest available method of financing construction of the various proposed works. The estimated cost of two treatment plants, several sewer outfalls, and a drainage system is $65,000,000.

Copies of the 280-page survey may be purchased from the Vancouver and Districts Joint Sewerage and Drainage Board at $10 each.

Statler Breaks Ground For Large Dallas Hotel

Ground was recently broken in Dallas, Tex., for one of the largest hotels to be built anywhere in the world in more than a quarter of a century—an 18-story 1,000-room Statler, which will be constructed at a cost of $15,000,000. Embodying new building techniques that are expected to cut construction time and costs, the hotel will be the first multi-story building to make full use of "flat-slab cantilever" construction. Employment of the cantilever principle, according to the architect, will eliminate about half the columns and footings necessary in older-type buildings. In addition to lowering costs, the method will be of great practical advantage since columns must either be concealed or, where concealment is not possible, given an exterior beautifying treatment.

A "United-Nations"-type structure, the building will be the first of ultra-modern design in Dallas. Though the exterior walls will have the appearance of glass and aluminum, they will actually be of metal treated with porcelain to give a glasslike texture. They will be prefabricated in sections to expedite construction and to permit completion of the building by the late summer of 1955.

Structural engineers on the project are Seelye, Stevenson, Value & Knecht, of New York City. The architect is William B. Tabler, of New York, and the contractor, Robert E. McKee General Contractor, Inc., of Dallas.

Huge Merchandise Mart Planned for New York

Air rights over the Pennsylvania Railroad tracks between Ninth and Tenth Avenues and 31st and 33rd Streets in Manhattan have been contracted for by Webb & Knapp, New York realty investment and building organization, as a preliminary step in a plan to develop the site with a huge merchandise mart that would be a "showcase" for American products. The proposed structure would provide a floor area of between 6,000,000 and 7,000,000 sq ft—nine acres of space to the floor and three times the floor area of the Empire State Building.

The projected 20-story metal and glass building will have floors capable of bearing heavy loads, and a flat roof to permit deliveries by helicopter. In addition to showrooms, the structure will house offices for the huge staff involved, several restaurants and service shops, its own hospital and fire department. It is estimated that, at peak tenancy, the building will have as many as 70,000 employees.

Many engineering problems in connection with the project are already being worked out. These involve the provision of street and parking facilities and of an extension to connect with the third tube of the Lincoln Tunnel now under construction. New tracks will be installed on the south side of the plot to provide for interior rail-loading facilities. In order to keep the main-line tracks clear of obstructions, two of the largest steel girders ever fabricated for such a structure (85 and 63 ft) will be required. The cost of providing foundations and a base for the building will be $11,000,000. Engineering details will be handled by R. E. Dougherty, Past-President of ASCE, who retired a few years ago as vice-president of the New York Central and is now a consultant in the offices of Seelye, Stevenson, Value & Knecht.

The project will involve an overall investment of almost $100,000,000—an expenditure that "could be justified only by the erection of a structure permitting this base cost to be spread over a vast rental area," according to the sponsors. Plans for financing are well advanced, with transactions under way for leasing one-third of the structure to the government to provide more adequate central postoffice facilities.

Three Companies Receive Lincoln Tunnel Contract

The Port of New York Authority has awarded a $17,260,370 low-bid contract, the largest single award in the construction of the $90,000,000 third tube of the Lincoln Tunnel, to three joint bidders—the Mason and Hanger Co., Inc., the Arthur A. Johnson Corp., and MacLean-Grove and Co., Inc. Construction of 6,258 ft of the 7,994-ft tunnel will be covered by the joint contract, which will include cutting through 720 ft of solid rock under the Palisades. As a preliminary to construction, the contractor will erect a giant shield, 20 ft long and 31 ft in diameter, at the bottom of the 55-ft-deep New Jersey shaft facing towards New York.

Driving the tunnel is scheduled to begin in April 1954 and to be completed in the fall of 1956. When the entire two-lane third tube is completed in 1957, it will increase by 50 percent the annual capacity of the tunnel and double peak-hour capacity in the preponderant direction of traffic.

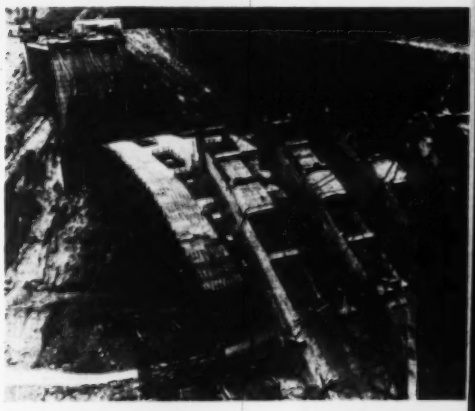
Graduate Fellowships in Science Offered

More than 700 graduate fellowships in engineering and science will be available for the academic year 1954–1955 in the National Science Foundation's Third Annual Graduate Fellowship Program. The closing dates for receipt of applications are December 15, 1953, for postdoctoral applicants, and January 4, 1954, for graduate students working toward advanced degrees in science. The winners will be announced by April 1, 1954.

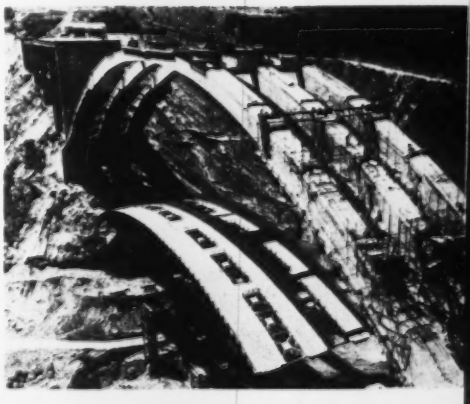
American citizens who will begin or continue their studies at graduate level in the mathematical, physical, biological, medical, and engineering sciences during the year are eligible for the fellowships. Selection will be made solely on the basis of ability, with the majority of the fellowships going to graduate students seeking master' or doctors' degrees in science. Stipends will range from $1,400 to $3,400 a year.

Request for application forms should be made to the Fellowship Office, National Research Council, 2101 Constitution Avenue, N.W., Washington 25, D.C.

Bridges South of the Border



Freedom of form previously available only with concrete has been achieved with steel in a bridge (left, above) that spans the Rio Blanco near Vera Cruz, Mexico. By application of welding techniques, Mexican engineer Camilo Piccone has projected a span with slender arch ribs, free of cumbersome bracing. The structure, which was opened last May, is based on a new design conception by Thomas C. Kavanagh, M. ASCE, chairman of the department of civil engineering at New York University. The ultra-modern "basket handle" effect is heightened by the use of color — orange and cherry red. Part of the Mexican federal highway system, the 250-ft-long, all-welded structure accommodates three lanes of traffic. Contractors and fabricators were the firm of Estructuras, S de R.L., of Monterrey. View at top right shows the first highway suspension bridge to use only diagonal cables with no steel girders and no vertical suspension ropes, which has been completed across the Rio Lempa in El Salvador, Central America, by the John A. Roebling's Sons Corporation, of Trenton, N.J. Located on the new Coastal Highway southeast of the capital city of San Salvador and called the San Marcos Bridge, the $2,500,000 bridge is one of the longest (about half a mile) in Latin America. Its five suspended spans use the novel cable-truss system, developed by Roebling engineers, which carries all dead and live loads by means of a network of diagnoal members acting as web members of a truss.



These three photos (to the right and below) show stages in the erection of the third and last prestressed concrete arch bridge on the Caracas-La Guaira Autopista (see "Civil Engineering" for March). The present structure, which has a 478-ft span, was completed in September. It was designed by Eugene Freyssinet, and constructed by Entreprises Campenon Bernard, with Robert Shama, M. ASCE, chief engineer. First concrete was poured in September 1952, and the central arch form was hoisted into position in June 1953 (photo upper right). By the end of July the arch ribs were completed, and the form was lowered to the ground (view at immediate right). The substantially completed structure is shown in the photo at the bottom of the page, taken on September 15, 1953. The prestressing steel has an ultimate strength of 255,000 to 260,000 psi, was post-tensioned to 150,000 to 160,000 psi, and is expected, after all relaxation, to retain a tension of 115,000 to 120,000 psi. The Autopista will be opened to traffic late this year.

New Steel Bridges Receive AISC Aesthetics Awards

Bridges in Texas, Tennessee, and Florida have been selected as the most beautiful steel bridges in the country opened to traffic in 1952 in the American Institute of Steel Construction's 25th annual Aesthetic Bridge Competition. Stainless steel plaques will go to the three winners. Certificates of honorable mention will be awarded to three other structures located in New Jersey, New York, and Pennsylvania. The jury of award, consisting of three architects, an engineer, and the director of an art museum, did not present an award this year in Class I, for bridges with spans of 400 ft or more.

In Class II, for bridges with spans under 400 ft and costing over $500,000, the award goes to the Neches River Bridge at Beaumont, Tex. Owned by the State of Texas and designed by the Texas Highway Department, the structure was chosen "for its clean design, which is devoid of extraneous ornamentation," and praised for its "serene and graceful lines." The fabricator was the Bethlehem Steel Co.

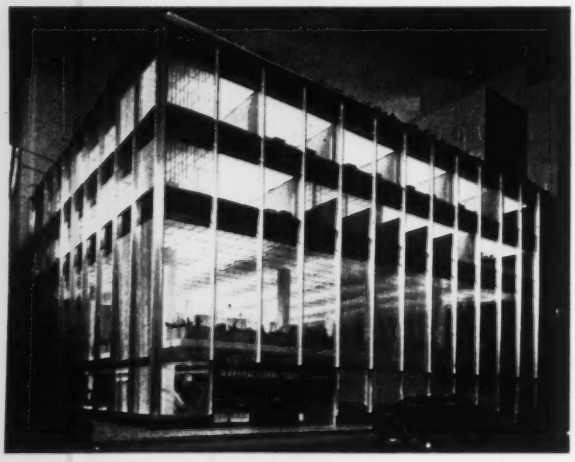
The Morris Ferry Bridge in Franklin County, Tennessee, is the winner in the Class III category for bridges with spans under 400 ft, costing less than $500,000. Selected "because the design is coherent and restful," the bridge was designed by the Corps of Engineers, Tullahoma District, and fabricated by the Nashville Bridge Co. The owner is the Franklin County Highway Commission.

In Class IV, for movable bridges, the prize-winning structure is the S.E. Fourth Avenue Bridge over Miami Canal, Miami, Fla., owned by the Dade County Board of County Commissioners: designed by the Rader Knappen Tippetts Engineering Co., Miami; and fabricated by the Nashville Bridge Co. Hardesty & Hanover, of New York, were consultants on the movable span. The bridge was chosen as representing "a direct approach to a difficult problem—crossing a stream with an acute angle with a movable span."

In Class II, honorable mention goes to the Delaware River Bridge between Trenton, N.J., and Morrisville, Pa., designed by the J. E. Greiner Co., and fabricated by the American Bridge Division of the U.S. Steel Corporation. The owner is the Delaware River Joint Toll Bridge Commission. In Class III, honorable mention goes to two structures—the Pickens Bridge, Washington-Sullivan Counties, Tennessee, and the Pedestrian Overpass, East Memorial Shoreway, Cleveland, Ohio. Owned by Washington-Sullivan Counties, the Pickens Bridge was designed by the Tennessee Valley Authority and fabricated by the American Bridge Division of the U.S. Steel Corporation. The Pedestrian Overpass is owned by the Ohio Department of Highways, which was also the designer, and was fabricated by the Mount Vernon Bridge Co.

S. E. Fourth Avenue Bridge over Miami Canal is prize-winning structure in Class IV in AISC 1952 competition for aesthetic steel bridges. Designer was Rader Knappen Tippetts Engineering Co., Miami, and Hardesty & Hanover, of New York, was consultant on the movable span.

New York Bank to Utilize Ultra-Modern Design



An entirely new kind of bank building, with an exterior of plate glass and polished aluminum, is being erected by the Manufacturers Trust Co., on a 100- by 125-ft corner site at Fifth Avenue and 43rd Street, New York. The $3,000,000, four-storied, air-conditioned structure (shown here as a photograph of a scale model) will have an almost entirely sealed glass exterior that will afford a panorama of activity within the bank. Of curtain-type construction, the exterior glass wall will hang from cantilevers at each floor supported by but eight interior columns set 19 ft back from the sidewalk. The main framing is steel, with close-spaced concrete joists bridging the intermediate spans. The walls will be washed and maintained by use of a scaffolding arrangement that will operate from built-in suspenders at roof level. Mechanical, electrical, and acoustical facilities will be hidden in a sandwich-type luminous ceiling. Escalators serve upper floors. Construction started in June and is expected to take about a year. Skidmore, Owings & Merrill are the architects, Weiskopf & Pickworth the structural engineers, and the George A. Fuller Co., the contractor on the project.

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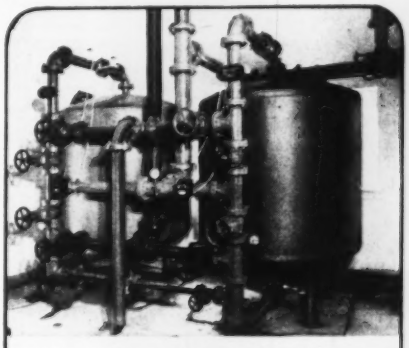
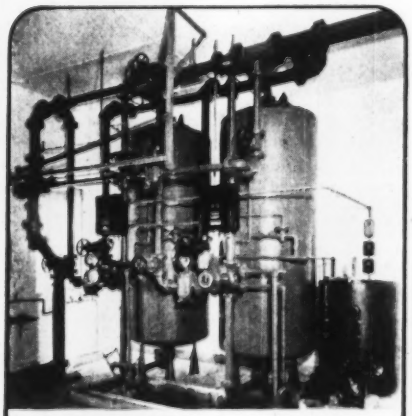


Compact Permutit pressure filters have a 150 gpm capacity...remove iron oxidized in coke-tray aerator, reduce turbidity.



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September Construction Expenditures at August Peak

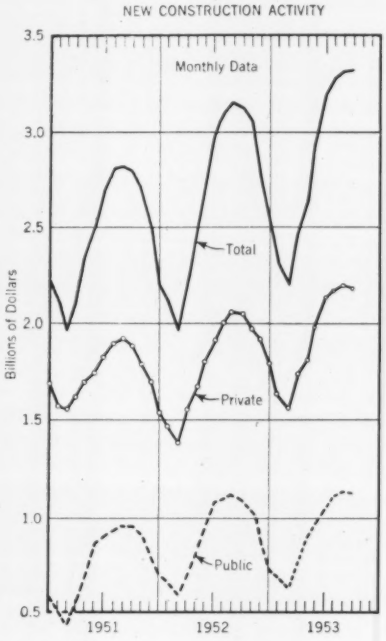
Expenditures for new construction in September, totaling $3.3 billion, were virtually the same as the record August figure and 5 percent above the September 1952 total, according to preliminary estimates of the U.S. Labor Department's Bureau of Labor Statistics and the Building Materials and Construction Division of the U.S. Department of Commerce. Private construction alone accounted for the entire increase over 1952. Private expenditures for new construction ($2.2 billion) were 8 percent above the September 1952 figure, while total public outlays ($1.1 billion) were about the same as a year ago.

Commercial building rose contra-seasonally to a new peak this September, and private outlays for public utility construction held at the record August level. Residential building declined about seasonally during the month. Private industrial building, which normally rises in August and September, remained steady for the second successive month after a gradual decline earlier in the year. Highway construction declined slightly less than seasonally from the record August figure, and public school building continued the upward trend that began in March. Military and naval construction has remained at the same dollar level for the past four months.

For the first nine months of 1953, expenditures for all types of new construction, totaling $25.9 billion, were 7 percent above the January-September 1952 total. Physical volume (expenditures adjusted for cost changes) also was up moderately from last year.

Private construction outlays maintained about a 9-percent lead over 1952 in each of the first three quarters of 1953, and by the end of September totaled $17.5 billion. The increase from a year ago occurred chiefly because of substantial gains in commercial building, and increased private spending for public utility and residential construction. Private educational and religious building increased about 20 percent over 1952, and private outlays for new industrial plant were practically unchanged.

Total public expenditures for new construction thus far this year ($8.4 billion) are about 5 percent above the January-September 1952 total. However, the margin of increase over 1952 has narrowed from about 10 percent in the first quarter to 3 and 2 percent in the second and third quarters, respectively. The gains this year largely reflect more spending for highways and public industrial plant. Increased outlays for schools and for sewer and water facilities have also contributed to the overall 1953 rise in public activity. Expenditures for military and naval facilities were about the same in both years for the nine-month period.



September construction expenditures, at 3.3 billion, are almost at record August peak and 5 percent above September 1952 figure, according to Department of Commerce curves.

Nine Saline Water Projects Approved

Renewed search for the most economical and efficient methods of converting salt and brackish water to fresh water suitable for human consumption, irrigation, or industrial purposes was called for by Douglas McKay, Secretary of the Interior, in announcing approval of nine new research contracts. The projects under way cover varied fields, with the primary objective the discovery of a process that will reduce production costs. In fact, several processes are now in operation, but production costs are so high that their use in most cases is limited.

Dr. O. G. Lof, of Denver, has one of the new contracts, which calls for the determination of the best method of low-cost demineralization of saline water through the use of solar energy. The University of Florida has contracted to conduct laboratory research in the development and testing of synthetic osmotic membranes to be used in separating salt from water. Yale University will conduct investigations of a method of improving heat-transfer rates in vapor compression evaporators, said to be the most economical and efficient method of conversion known today. In this method, it may be found practical to use smaller operating temperature differences without significant changes in heat transfer area with resultant reductions in energy requirements of vapor compression distillation.

A study under George W. Murphy, professor of chemistry at the State University of New York at Albany, will seek to determine more exactly the actual energy demands, including energy losses, as compared with basic theoretical thermodynamic energy requirement. The results of this project will be used in studying the potentialities of actual and proposed separation processes as a guide to future research. The Heinz Engineering Co., of Arlington, Va., has been assigned the study of developing an improved method for analyzing vapor compression distillation cycles, and the Battelle Memorial Institute at Columbus, Ohio, will undertake studies in the evaporation of saline waters by steam from solar radiation.

A large contract already under way with Ionics, Inc., of Cambridge, Mass., is investigating the process variables of an electrical membrane demineralizer applied to typical brackish waters and to sea water. Other investigations are under way at the South Dakota School of Mines, the Texas A & M Research Foundation, the University of Minnesota, and the University of California at Berkeley.

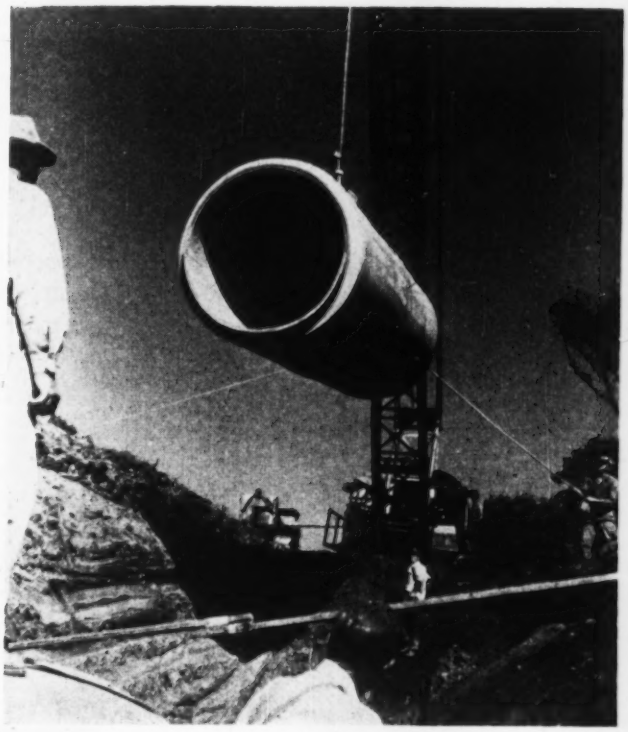
With shortages of potable water approaching the critical stage in many areas, use of converted sea water is believed by experts to offer a solution. The entire program is being carried on by the Department of the Interior under the terms of Public Law 448, for which Congress appropriated $400,000 for the current fiscal year.

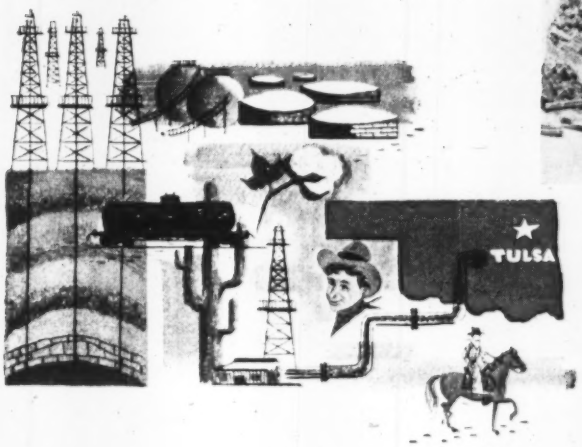
AEC Appoints New General Manager

The resignation of Marion W. Boyer as general manager for the Atomic Energy Commission and appointment of Maj. Gen. K. D. Nichols, wartime district engineer for the Manhattan District, to succeed him, are announced by the AEC. General Nichols will retire from military service upon taking the AEC appointment, which will be effective November 1. He is now on duty in Washington as Chief of Research and Development, U.S. Army.

Another AEC release announces that an agreement has been approved with the Duquesne Light Co., of Pittsburgh, and the Walter Kidde Nuclear Laboratories, Inc., of Garden City, L.I., governing a nuclear power reactor study. The two companies make up the sixth team from private industry to engage in power studies under the AEC's Industrial Participation Program. The work will include a survey of the feasibility of design, construction, and operation by private industry of power-producing reactors.

Tulsa Prefers Concrete Pressure Pipe





In 1923 when Tulsa reached out to Spavinaw Creek for pure, spring-fed water it selected concrete pressure pipe for the flow line. Fifty-two miles of 54- and 60-inch concrete pressure pipe were installed to carry a maximum of 25 mgd.

Twenty-eight years later Tulsa's phenomenal growth necessitated increasing its water supply, and the city again chose concrete pressure pipe. The new line, completed last year, using 66- and 72-inch pipe, parallels the original installation boosting Tulsa's total pipeline capacity to 63 mgd.

The confidence Tulsa engineers have in concrete pressure pipe is evidenced by the fact that it was selected a second time for the city's water supply system. The original installation had proven that concrete pressure pipe is efficient, economical, and lasting.

If your city is planning additional water lines, or replacements for old lines, be sure to investigate the distinct advantages of concrete pressure pipe.

Water for Generations to come

Concrete PRESSURE Pipe

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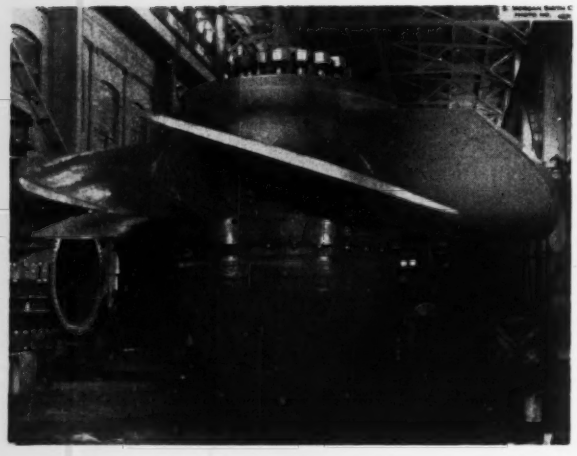

Huge Turbine for McNary Dam Is Built in Eastern Shop

Runner and hub of one of the fourteen turbines for McNary Dam in the Pacific Northwest are being manufactured in the shop of the S. Morgan Smith Company, at York, Pa. Of the Smith-Kaplan type, the turbine has six blades, each of which weighs 30,000 lb and is 12 in. thick in its heaviest portion. The blades and the hub, which is filled with oil during actual operation, will be removed for shipment. Each turbine unit will have 111,300 hp, travel speed of 85.7 rpm under an 8-ft head—roughly equivalent to a speed of 75 mph—and weight of 2,000,000 lb. It will be able to service 120,000 families. Total generating capacity of all 14 turbines will be 980,000 kw.

Funds Allocated for New Flood Control Studies

Funds appropriated by Congress for Army Corps of Engineers general flood control surveys have been allocated to 38 studies in 25 states and Alaska, according to an announcement from the Department of the Army.

Some of the bodies of water studied under the $660,000 allocated for the purpose will be the Mississippi River at St. Paul, Minn., and St. Louis, Crystal, and Festus, Mo.; southern Louisiana streams and bayous; Alaska rivers and harbors; the Mojave and Eel rivers, the Sacramento San Joaquin river delta, and Alameda Creek in California; the Miami River in Florida; the Alabama-Coosa River in Georgia; the Middle Snake River in Idaho and Oregon; the Wabash and Maumee rivers and the Mahoning-Grand river basins in Indiana and Ohio; the lower Columbia River in Washington and Oregon; and the Trinity Bay Soil Conservation District in Texas.

John MacLeod Nominated For Presidency of AGC

The nomination of John MacLeod, president of Macco Corp., of Paramount, Calif., for the 1953 presidency of the Associated General Contractors of America is announced by the association. George C. Koss, M. ASCE, president of the Koss Construction Co., of Des Moines, Iowa, has been nominated for vice-president. The nominations were made by the AGC Governing and Advisory Boards at a recent meeting in Chicago.

Voting will be by letter ballot in December, and the new officers will be installed at the conclusion of the AGC annual convention in Los Angeles in March 1954.

N. G. Neare's COLUMN

R. ROBINSON ROWE, M. ASCE

"I wish now," moaned Professor Neare, "that I hadn't sort of promised to cadge a hydraulic puzzle from the Tony Falls hydromantics. I asked, begged and coaxed, but got nothing. I blenched, boyered, howed, poscyed, powelled and straubed—but got nothing—nothing much but incoherencies on aerated flow. I did notice. . ."

"Excuse me," begged Joe Kerr, "but did you forget about having a Guest Professor?"

"Almost. I'd guess, Stoop, that Joe had an answer."

"He should have, Noah, because I gave him a cut-and-try assignment. The general idea was to draw lines from each vertex of a 13-14-15-ft triangle, dividing the opposite sides in the same proportion and thereby describing an inner triangle which was an aliquot part of the primitive triangle. Specifying also that one of the 3 lines must meet the opposite side at a foot mark, I asked Joe to find a second of the 5 solutions, we having found the first at the 5-ft mark on the 15-ft side."

"And I did it," beamed Joe. "I figured that a small triangle had the best chance of being an aliquot part, so I drew the first line to the 7-ft mark on the 15-ft side and the other two lines according to your rule. Planimetering the inner triangle carefully, I found its area to be 0.5 sq ft, or $^1/_{168}$th of the 84 sq ft in the 13-14-15-ft triangle."

"Lucky boy!" proclaimed Cal Klater. "You probably didn't know that if your first line divided the opposite side into segments a and b, the ratio of areas would be:

$$\frac{ABC}{DEF} = \frac{a^3 - b^3}{(a - b)^3}$$

When you made $b = 7$ and $a = 8$, the ratio became 169 instead of 168, so you guessed right wrongly from a small error in your planimetering.

"In order to get all solutions for which the ratio is an integer (reciprocal to the aliquot part), let $b = kr$ and $a = k(r + 1)$, making the ratio $R = (r + 1)^3 - r^3$, which is an integer for any integer r. The side divided at a foot mark has a length $a + b = k(2r + 1)$, so we get a solution for each odd factor $2r + 1$ of the numbers 13, 14 and 15—that is, for 1, 3, 5, 7, 13 and 15. In order, $r = 0, 1, 2, 3, 6$ and 7, and $R = 1, 7, 19, 37, 127$ and 169. The first is trivial, the second found before, and the others the 4 new ones you asked for."

"Accepted," said Guest Professor Nagle, "and I'd like to comment on ratios of other areas in such dissections, but Noah looks impatient to finish his speech."

"Thanks, Stoop. As I was saying, I did notice the care and precision used in calibrating a measuring tank, which had the form of an uncovered cube. Instead of unscientifically computing incremental volumes from measured dimensions, a staff gage was attached to one edge of the tank with its zero at the bottom and an inflow of 3 cfs was precisely timed to each foot mark. If times were 16, 79 and 194 sec, respectively, at 4, 7 and 10-ft marks, when was the tank full to overflowing?"

[Cal Klaters were Flo Ridan (Charles G. Edson), Richard Jenney, Gee (Morton S.) Raff, Rudolph W. Meyer, and John C. Moses. Guest Professor Stoop Nagle was John L. Nagle. Also acknowledged from Gee Raff is a dexterous shuffling of August's picnic tables.]

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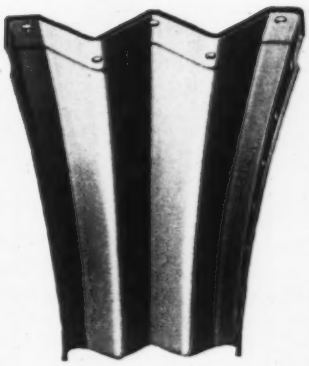

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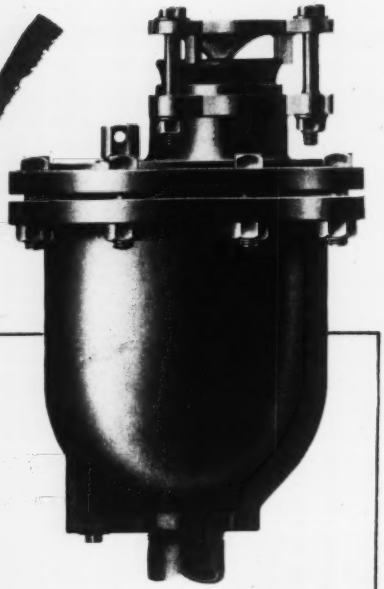

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DECEASED

Oswald Hewitt Dodkin (M. '48), age 51, associated with the Brazilian Traction, Light and Power Co., and its subsidiaries since 1926, died in São Paulo, Brazil, on September 7. Mr. Dodkin began his career with the Brazilian utility company as testing engineer for its subsidiary, São Paulo Tramway, Light and Power Co., Ltd., holding at various times the positions of hydraulic engineer and chief hydraulic engineer. At the time of his death he was head of the planning section. He graduated from Worcester Polytechnic Institute in 1923.

Oswald H. Dodkin

Verle Lorraine Austin (M. '48), age 57, office engineer in charge of computations for the Water Resources Branch, U.S. Geodetic Survey, at Austin, Tex., died recently. Mr. Austin had been connected with the Survey continuously since 1922, when he joined it as a junior engineer at Kansas City shortly after graduation from the University of Kansas. In 1930 he was assigned to the Austin district office where he had been in charge of office computations of stream-flow records for the past 15 years.

Romeo Thompson Betts (M. '09), age 86, who recently retired as chief engineer and executive vice-president of the Robbins Ripley Co., of New York, died at Summit, N.J., on September 13. Mr. Betts had been connected with the firm continuously for 33 years, and before that was with the New York City Department of Docks and Ferries for 21 years. He was a member of the 1890 class of Columbia College.

Arthur Horace Blanchard (M. '09), age 76, consulting highway and traffic engineer of Sparta, N.J., died at Newton, N.J., on September 1. A graduate of Brown and Columbia universities, Mr. Blanchard served on the faculties of Brown (1899–1911); Columbia (1912–1919); and the University of Michigan (1920–1926). Since 1927 he had maintained a private practice, successively at Toledo, Providence, and Sparta. He was a former executive director of the National Highway Traffic Association.

Charles Worthington Comstock (M. '05), age 83, retired consulting engineer of Jackson Heights, N.Y., died in Denver, Colo., on September 18. An alumnus of the Colorado School of Mines and Cornell University, Mr. Comstock taught at both colleges for several years. Prior to opening a consulting office in New York in 1932, Mr. Comstock had engaged in private practice in

the West for 17 years, and was with Dwight P. Robinson & Co., Inc., New York, and the Electric Bond & Share Co., in Brazil and India. He served a four-year term as State Engineer of Colorado.

Clyde Craggs (M. '34), age 56, for the past 15 years chief engineer of the United States Smelting, Refining and Mining Co., at Salt Lake City, Utah, died there on August 28. From the time of his graduation from Valparaiso University in 1917 until 1938, Mr. Craggs was with the Worden Allen Co., of Milwaukee, except for a two-year period with Oglebay Norton & Co., of Cleveland.

Bert Emerson Dodge (M. '48), age 65, structural engineer with the Universal Atlas Cement Co., in New York City, from 1925 to 1932 and continuously since 1936, died on August 18. He had also been connected with the Wisconsin and Illinois highway departments, the Standard Oil Company of Indiana, and the U.S. Engineer District at Chicago. Mr. Dodge was an alumnus of the University of Kansas.

Walter Louis Drager (M. '27), age 67, former chief engineer of the Reconstruction Finance Corp., and the Defense Plant Corp., in Washington, D.C., died on August 10 at Long Beach, Calif., where he had been residing since his retirement five years ago. Prior to his 16-year period of service with the RFC, Mr. Drager was assistant city engineer of Auburn and Schenectady, N.Y.; engineer for the U.S. Reclamation Service, the Public Utilities Commission, and the New Jersey State Water Policy Commission; and chief engineer for the J. G. White Co., on construction of the Calles Dam in Mexico. He attended the University of California and Cornell University.

Archibald Livingstone Parsons (A.M. '02), age 77, former chief of the Bureau of Yards and Docks (1929-1933) who retired with the rank of rear admiral in 1938, died on September 24. Entering naval service in 1903, as a lieutenant in the Civil Engineer Corps, Admiral Parsons was assigned to the Bureau in 1912 and served as assistant to the chief from 1916 to 1918. He also held assignments as head of naval yards in Philadelphia, Boston, New York and the Republic of Haiti. Upon his retirement Admiral Parsons joined Frederic R. Harris, Inc., New York, N.Y., as consulting engineer. He was an alumnus of the Massachusetts Institute of Technology.

A. L. Parsons

Louis Warren Duffee (M. '48), age 67, consulting engineer of Laurel, Miss., died on May 9. From 1908 to 1921 Mr. Duffee was employed by the Gulf, Mobile &

(*Continued on page 94*)

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(*Continued from page 93*)

Northern Railroad in various capacities including chief engineer. Following a twelve-year period in private practice in Laurel, he was project engineer for the Mississippi State Highway Department. For several years he was with the Federal Works Agency at Jackson, Miss., and Atlanta, Ga. Mr. Duffee was a graduate of Alabama Polytechnic Institute.

Leon C. Heilbronner (A.M. '16), age 66, retired engineer of São Paulo, Brazil, and an alumnus of Union College, died in Philadelphia, Pa., on September 12. At the time of his death, he was director of Thela Comercial S.A. and Arno S.A. Industria e Comércio. Mr. Heilbronner, who was credited with installation of the first cement plant in Brazil, was managing director of the Portland Cement Co. of Brazil and president of Soc. Technica e Commercial Ltda., and held key positions in several other Brazilian business organizations.

Harold Ezra Hilts (A.M. '10), age 71, deputy commissioner of the U. S. Bureau of Public Roads, died at his home in Silver Spring, Md., on September 5. Connected with the Bureau since 1932, Mr. Hilts was previously with the Portland Cement Association, the Lone Star Cement Co., and the Pennsylvania State Highway Department. For the past seven years he had been chairman of the Committee on Planning and Design Policies of the AASHO. He was also a member of a United Nations group preparing an international system of highway signs and signals, and had been chief of a highway mission to Turkey. He was an alumnus of the University of Pennsylvania, class of 1905.

Edward Clinton Jansen (M. '24), age 74, retired engineer of Denver, Colo., died at his home in that city after a long illness, on September 1. For more than 35 years Mr. Jansen was associated with the Public Service Co. of Colorado—in later years as chief hydraulic engineer. He retired in 1946 because of ill health.

Percy Coleman Kuhn (A.M. '27), age 54, for the past ten years consulting structural engineer in New Orleans, La., died in that city on August 31. Early in his career, Mr. Kuhn was associated with the Truscon Steel Co., as manager of its New Orleans office and, during World War II, was in charge of naval repairs for the Todd-Johnson Dry Docks. Mr. Kuhn was a 1922 graduate of the University of Virginia.

Ralph Irving McCorkindale (M. '28), age 71, who retired in 1951 as chief engineer in charge of construction and maintenance for the Ludlow Manufacturing & Sales Co., Ludlow, Mass., after 13 years of service, died on September 18. Prior to his association with the Ludlow firm, Mr. McCorkindale was employed by L. E. Locke & Sons, Lawrence, Mass., and the Ludlow Jute Co., Calcutta, India; and served as resident engineer for the Boston firm, Chas. T. Main, in Texas and Alabama for 14 years. Mr. McCorkindale studied at Rensselaer Polytechnic Institute.

Wesley Edwin McCune (Aff. '48), age 45, since 1946 head of the McCune Construction Co., of Kansas City, Mo., died in Chicago, Ill., on August 27. Mr. McCune had supervised construction work for several firms, including the Patti MacDonald Construction Co., Kansas City, Mo.; the Waco Construction Co., Waco, Tex.; the Tarlton-MacDonald Construction Co., St. Louis, Mo.; and the Meyer Construction Co., San Francisco, Calif.

Conrad Olai Mannes (M. '48), age 67, city engineer of Kelso, Wash., died there on August 14. At various periods he served as city engineer for Tenino and Shelton, Wash., and county engineer for Thurston and King Counties (Washington). Mr. Mannes had also been employed by several Seattle firms, including the Valley Construction Co., and DeWitt C. Griffin & Associates.

Frederick William Morrill (M. '44), age 68, structural engineer with the Ferro Concrete Construction Co., Cincinnati, Ohio, died in that city on May 25. He had been continuously associated with the company for 38 years. Active in Society and profes-

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sional affairs, Mr. Morrill was a past-president of the Cincinnati Section and a member of the Cincinnati Building Code Revision Committee. He was a graduate of the Massachusetts Institute of Technology, class of 1907.

Nolan Page (A.M. '38), age 47, lieutenant colonel, Corps of Engineers, at San Francisco, Calif., died in Washington, D.C., on December 27, 1952. Colonel Page had been on active duty since 1940, serving in the Office of the Chief of Engineers, Washington, D.C., for the first six years and for brief periods in Japan and Korea. Before entering military service, he was engaged in research for the U.S. War Department at the University of Iowa for ten years. He graduated from Oregon State College and the University of Iowa.

Ray Seely (M. '20), age 77, project engineer with the Indiana State Highway Department at Hammond, died on May 22. Early in his career (1906–1922) Mr. Seely was deputy county engineer and county engineer for Lake County, Indiana, and from 1906 to 1930, city engineer of Hammond. He also had a private consulting practice in the same city from 1922 to 1932 and from 1940 to 1950.

Harold James Seymour (M. '43), age 62, since 1950 city engineer of Elizabeth, N.J., died on September 15. He had previously been assistant city engineer for 35 years. Mr. Seymour worked on plans for grade-crossing elimination on the Long Branch Division of the Central Railroad of New Jersey, expansion of the Newark Airport and on the $5,000,000 intercepting sewer to end pollution of the Arthur Kill River.

Julian Tate Stafford (A.M. '32), age 52, since 1944 engaged in his own practice as a consulting engineer in Los Angeles, Calif., died on August 4. Mr. Stafford's experience was with the American Bridge Co., Gary, Ind., and the P. J. Walker Co., Berkeley, Calif. During World War II he was civilian planning coordinator for construction work in the 11th Naval District. Mr. Stafford graduated from the University of California in 1925.

Henry Case Willcox (A.M. '22), age 60, since 1951 director, Tactical Division, Federal Civilian Defense Administration, Washington, D.C., died on September 16. Colonel Willcox's military career included duty on the Mexican border in 1917; an assignment with the British Lake Tsana expedition; and (from 1940 until 1949) service as executive officer of the Construction Branch, Office of the Under Secretary of War, and chief engineer, Services of Supply and chief of the strategic logistics section in the China-Burma-India theater. He had also served on commissions to Romania, Turkey, and Russia. From 1925 to 1933, he had a private consulting practice in New York. Colonel Willcox attended Cornell and Columbia universities.

NEWS OF ENGINEERS

Maurice L. Albertson, professor of civil engineering and head of fluid mechanics research at Colorado A & M College, has been granted a Fulbright Scholarship to study for a year at Grenoble, France. He will work at the Neyrpic Laboratories as well as the University of Grenoble.

E. W. Lane, formerly consultant for the U.S. Bureau of Reclamation at Denver, has accepted the position of professor of civil engineering at Colorado A & M College. The author of numerous articles on hydraulic engineering subjects, Mr. Lane was head of the hydraulic laboratories at the Bureau of Reclamation.

E. Robert Baumann has joined the civil engineering department and Engineering Experiment Station at Iowa State College as associate professor of civil engineering. Professor Baumann was formerly a research associate at the University of Illinois.

Cornie L. Hulsbos has been promoted from assistant to associate professor of civil engineering at Iowa State College.

Ross H. Bryan has opened an office in the Nashville Trust Building, Nashville,

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Tenn., where he will specialize in prestressed concrete design and fabrication and other structural problems. Mr. Bryan was a member of the recently dissolved Nashville engineering firm of Bryan & Dozier.

Frank Baron is now professor of civil engineering and director of the structural engineering laboratory at the University of California at Berkeley. He was previously professor of civil engineering at Northwestern University.

J. B. Converse, until recently president of J. B. Converse & Co., Inc., Mobile, Ala., is now chairman of the board with **H. E. Myers** succeeding him as president. The firm is celebrating its twenty-fifth anniversary this year.

Robert D. Dalton and **Robert D. Dalton, Jr.,** announce the formation of a partnership, Dalton and Dalton, Consulting Structural Engineers, at 374 Seventeenth St., Oakland, Calif.

Ralph Earle, president and treasurer of Thomas Earle & Sons, Inc., announces the firm's new office location—Western Saving Fund Building, southeast corner of Broad and Chestnut streets, Philadelphia 7, Pa.

John H. Ames recently retired as city manager of Ames, Iowa, after 26 years of service.

Fred L. Plummer was reelected president of the American Welding Society and took office for his second term at the society's 34th annual meeting held in Cleveland, Ohio, the week of October 19th. Mr. Plummer, a registered engineer in the states of Ohio, New Jersey and New York, is director of engineering for the Hammond Iron Works, Warren, Pa. For fourteen years he was a member of the faculty of the Case Institute of Technology. An alumnus of Case, he received a citation from the school in February 1953 for "having distinguished the college and himself through outstanding achievement in his chosen field."

Fred L. Plummer

W. J. Leary, former assistant state highway engineer for the Montana Highway Commission at Helena, was recently named director of public service for Helena.

Robert F. Legget, director of the Division of Building Research, National Research Council, Ottawa, Canada, was recently elected an honorary fellow of the Royal Architectural Institute of Canada. Earlier in the year he was chosen to present the sixth Wallberg Lecture at the University of Toronto.

Richard A. Haber has accepted an appointment as executive engineer for Michael Baker, Jr., Inc., Consulting Engineers, Rochester, Pa. Mr. Haber has been associated with the Delaware State Highway Department since 1936, recently as chief engineer and engineering consultant.

Gerald E. Hauer, a member of the American Well Works (Aurora, Ill.) engineering staff since 1946 and chief engineer since 1948, has been promoted to vice-president in charge of engineering.

Donald H. Herak has been promoted from field engineer to district engineer of the Spokane, Wash., office of the Portland Cement Association, effective October 1. He has been with the organization at Spokane since 1951.

Edward R. Higgins, for the past two years engineer for the Surety Association of America, New York, N.Y., resigned on October 1, to enter the insurance agency-brokerage field. His offices will be in the Lincoln Building, 60 East 42nd St., New York City.

Emerson C. Itschner, North Pacific Division Engineer for the Corps of Engineers at Portland, Oreg., since 1952, has been

(*Continued on page 98*)

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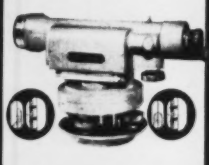

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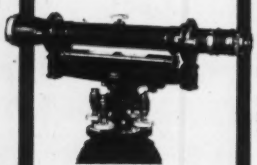

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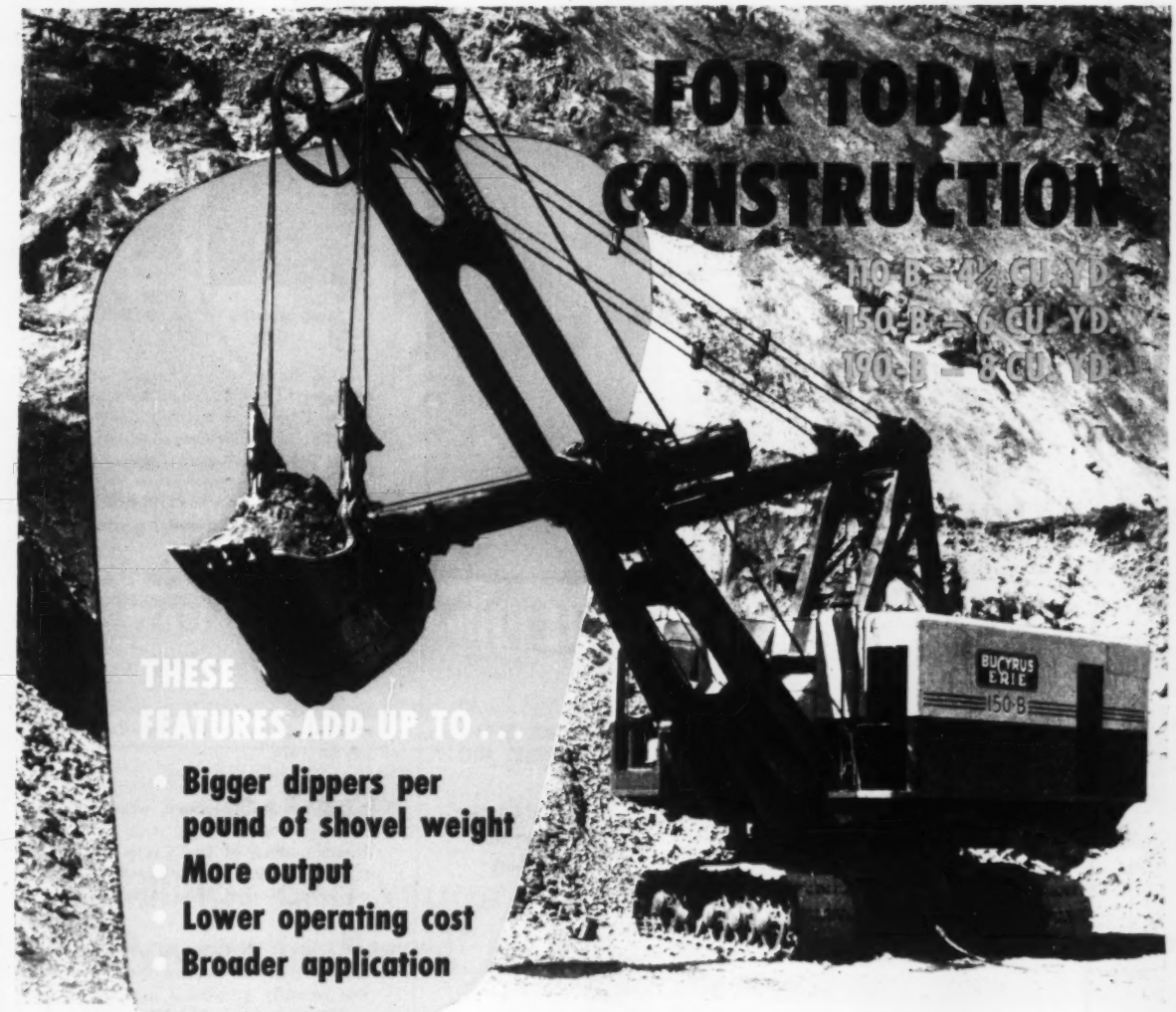
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(*Continued from page 96*)

assigned to the Office of the Chief of Engineers, Washington, D.C. General Itschner will be succeeded early in November by **Gen. Don G. Shingler,** chief of staff and assistant commander, Fort Belvoir, Va.

Jamil Malaika

Jamil Malaika has been promoted from assistant professor of civil engineering at the College of Engineering, Baghdad, Iraq, to a full professorship. In addition to his teaching duties, Dr. Malaika has been the assistant dean of the college since 1951.

A M Rawn, chief engineer and general manager of the Los Angeles County Sanitation Districts, with headquarters in Los Angeles, has been elected chairman of the State Water Pollution Control Board. A member of the board since its orgnization in 1949, Mr. Rawn has represented the field of public sewage disposal.

L. N. Rydland, lieutenant, U.S. Navy, who is serving at the Marine Corps Air Station, Kaneohe Bay, Hawaii, as assistant officer-in-charge of construction is the recipient of an honorable mention award from the chief of the Navy's Bureau of Yards and Docks for a paper on recent research work, entitled "Airport Surface Treatment for Jet Aircraft."

Charles R. Sansbury, who recently retired from active duty with the Louisville District office of the Corps of Engineers after 14 years of service, is planning to make Ft. Meyers, Fla., his future home.

George G. Shimamoto, an associate in the firm of Kelly & Gruzen, New York, N.Y., was recently granted a license to practice architecture in Japan by the Ministry of Construction—believed to be the only such license granted to a non-resident of Japan. He was also appointed a consultant to the Architectural Institute of Japan.

Robert E. Steacy has accepted a position as office engineer in the Louisville District office of the Surface Water Branch of the U. S. Geological Survey, following his recent release from active duty with the U. S. Navy.

A. K. Stillman, consulting engineer of Olympia, Wash., has established a partnership with **DeWitt C. Griffin,** to be known as DeWitt C. Griffin & A. K. Stillman, Consulting Engineers. The firm's offices are located at 525 Central Building, Seattle, Wash.

Fred F. Van Atta, manager of the Building Division, Carolinas Branch, Associated General Contractors, has been appointed

(*Continued on page 102*)

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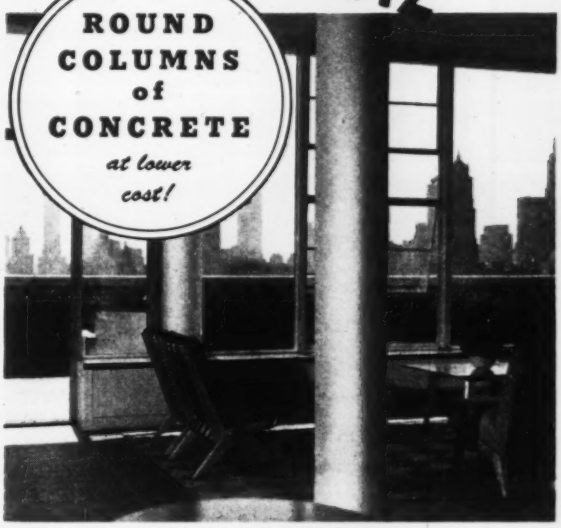

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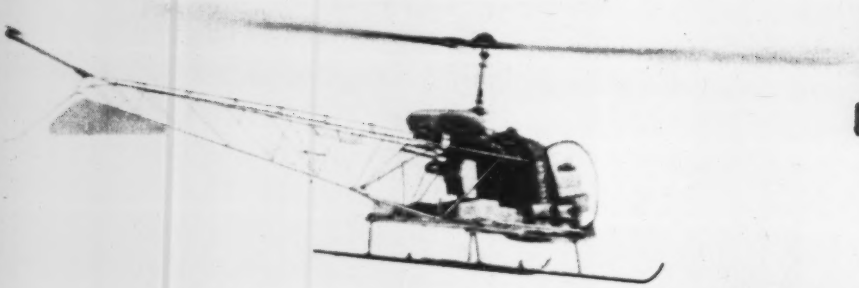
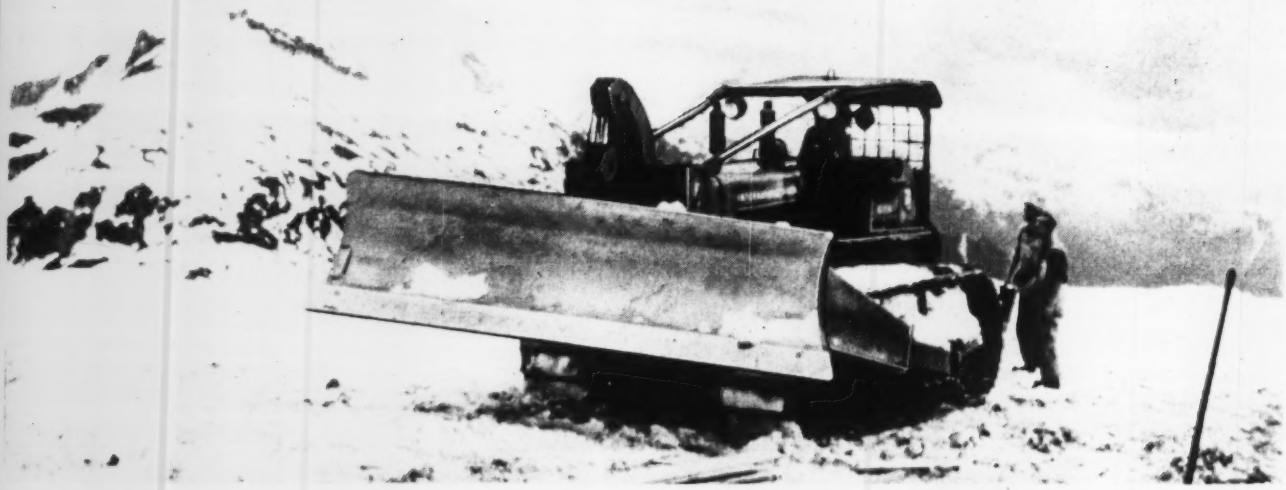
ESTABLISHING MOUNTAIN-TOP BASE, a helicopter and a TD-24 put men, machinery and supplies on mile-high pass as first step in efforts to build road down to meet section coming up from each side. TD-24 pulled yarder, winch, and compressor into pass after bitter 7-day fight.





1 **RAISING KENNEY DAM** to fill the Grand Canyon of the Nechako River, workers sluice down some of the 3.8 million cubic yards of earth and rock it will eventually contain. Dam will form a reservoir with twice the capacity of Grand Coulee. TD-24 in foreground strips blasted rock from canyon wall abutment.

2 **HEADING OPERATIONS** at Kenney Dam are (left to right) Alcan Resident Engineer Harry Jomini; General Superintendent "Hak" Nielsen and Project Manager Jack Bremner, both of Mannix, Ltd., sub-contractor for Morrison-Knudsen Company of Canada, Ltd. 110 miles west, dammed-up waters will be diverted through mountains and dropped a half mile to run turbines in sea-level powerhouse.

3 **DRIVING TEN-MILE TUNNEL** through mountain is done from four headings. Here, half a mile above ocean-level valley, aerial tramway has delivered TD-24 to tunnel portal for working debris down mountain. 2,600 feet below, eight-story powerhouse inside mountain is being mucked out by a TD-24 and a TD-9.

Red TD 24 Pioneers New Frontier

59 International TD-24s spearhead largest integrated engineering program in history for Alcan (Aluminum Company of Canada, Ltd.) on Project British Columbia

A fleet of 59 hard-hitting International TD-24s is blazing a new frontier across 5,000 square miles of wilderness in British Columbia.

Twenty-four hours a day, they're on the go for Morrison-Knudsen Company of Canada, Ltd., prime contractor for most of the giant development that includes:

Building the largest sloping clay core dam in the world

Driving a subway-size tunnel ten miles through a mountain

Blasting out an eight-story powerhouse two blocks long inside solid rock

Erecting a transmission line fifty miles long over a jagged mountain range

Raising the world's largest aluminum smelter and a new port city at Kitimat where 50,000 people may eventually live and work.

A. O. Strandberg, project manager for Morrison-Knudsen, says:

"These TD-24s are doing the impossible. We never thought any tractor could go where these tractors are working now. They have the weight, they have the balance, and they have the power to get the job done."

And here's what superintendents on the firing line say:

Bill Richards: *"They're pushing boulders uphill we had to dynamite in the old days."*

Herb Wilkinson: *"I wouldn't believe where they'd go until I got them on my crew."*

John Hutton: *"They're doin' work up here they were never built for but they're doin' it just the same."*

Your International Industrial Distributor can give you the facts and figures on the TD-24. See him. You'll be a TD-24 man from then on in!

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POWER THAT PAYS

4 **INSPECTING MOUNTAIN TOP OPERATIONS** at Kemano, headquarters for construction of powerhouse, tunnels and transmission line are (left to right) A. O. Strandberg, Project Manager for Morrison-Knudsen; F. T. Matthias, Alcan Assistant Project Manager, and Walter Abrahamson, Alcan Assistant Resident Engineer at Kemano.

5 **LINKING UP POWER TRANSMISSION LINE ROAD,** a pair of TD-24s doze toward each other through blasted rock. Across 50 miles of rugged terrain like this, a mountain-anchored powerline will be built to flash abundant electricity from mountain powerhouse to smelter at tidewater.

6 **NEW LAND IS MADE IN OCEAN INLET** by dredge which deepens anchorage for ocean shipping at the same time. H. M. Whiting (right), Project Manager for Kitimat Constructors, Ltd., and a superintendent study progress. Part of this 70 acres of new land will become site of new aluminum smelter. Town which may eventually become city of 50,000 will be built across the bay.

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ELIMINATED: Crippling accidents that slashed production.

SAVED: Lost man-hours and high insurance premiums.

Take a machine tool, surround it with oil-filmed flooring, and you've set the stage for a tragedy. This one—in a southern industrial plant—cost a skilled workman his arm.

Then we installed A.W. ALGRIP Abrasive Rolled Steel Floor Plate. Result: No more slipping accidents! For tough abrasive "grinding-wheel" grain, rolled deeply and densely into steel plate, makes ALGRIP truly non-skid. It's almost impossible to slip on this hard-gripping floor plate—even when it's wet or oily—even on steep inclines!

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(*Continued from page 98*)

special assistant on the headquarters staff of the American Society for Testing Materials, Philadelphia, Pa. Mr. Van Atta is also a former acting secretary-treasurer of the American Concrete Institute and editor of the *ACI Journal*.

J. H. Gilbert, until recently on active duty as a captain in the Civil Engineer Corps of the Navy, has become executive vice-president of the Capitol Engineering Corp., of Dillsburg, Pa. Captain Gilbert, whose last assignment was District Civil Engineer of the Potomac River Naval Command, Washington, D.C., has been on active duty since 1941.

J. H. Gilbert

Allen W. Keller, formerly with E. P. Goodrich, consulting engineer of New York City, has opened his own consulting office at 110 West 42nd St., under the name of Allen William Keller Associates. The new firm will specialize in mechanical and electrical engineering.

Ben Moreell, admiral, CEC, USN (retired), chairman of the board of Jones & Laughlin Steel Corp., Pittsburgh, Pa., recently accepted chairmanship of a task force of the Hoover commission to make recommendations on federal activities in the water resources and power fields.

James C. Marshall, brigadier general, U.S. Army (retired), has returned to his private practice in Skaneateles, N.Y., after completion of a two-year assignment as director of operations for the Koppers Co., at Zonguldak, Turkey—under a contract with the Turkish government for control and supervision of the construction of extensive harbor works and coal handling facilities.

Algert D. Alexis, rear admiral, U.S. Navy received the honorary degree of doctor of science from his alma mater, Lafayette College, on October 24. Admiral Alexis is director of the Atlantic Division of the Bureau of Yards and Docks with headquarters in New York City.

Joseph F. Jelley, Jr., rear admiral, U.S. Navy, has been appointed director of construction in the office of the Assistant Secretary of Defense, according to an announcement from the Department of Defense. Admiral Jelley will assume his new duties at the conclusion of his term as chief of the Bureau of Yards and Docks, Department of the Navy.

Arvin S. Wellborn, associated with the Asphalt Institute since 1949, has been promoted from managing engineer of the Pa-

(*Continued on page 104*)

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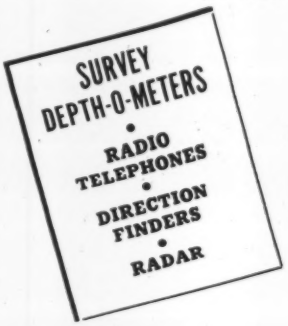

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(*Continued from page 102*)

cific Coast Division (San Francisco, Calif.) to chief engineer with headquarters at 801 Second Avenue, New York City.

Charles E. Cutts resigned recently as associate professor of civil engineering at the University of Florida to accept the position of engineer in the Division of Mathematical, Physical, and Engineering Sciences of the National Science Foundation in Washington, D.C.

William H. Hasselbach, director of engineering for the Libbey-Owens-Ford Glass Co., Toledo, Ohio, received a citation as a "distinguished alumnus" of the University of Michigan at the recent centennial of engineering education held in Ann Arbor, Mich., October 23 and 24.

George A. Quinlan has retired as superintendent of highways for the Cook County (Ill.) Highway Department, with headquarters in Chicago. His home is at Wilmette, Ill.

Non-ASCE Meetings

American Society of Mechanical Engineers. The annual meeting of the American Society of Mechanical Engineers will take place at the Statler Hotel, New York, N.Y., November 29–December 4.

Chi Epsilon. A meeting of the New York Alumni Chapter will be held in the Engineering Societies Building, Room 1101, 33 West 39th St., New York City, on December 2, at 7:30 p.m. It will be preceded by an informal dinner in the New York Times Dining Room, 11th floor, 229 West 43rd St., at 6 p.m.

Conference on Scientific Editorial Problems. The American Association for the Advancement of Science is sponsoring the second Conference on Scientific Editorial Problems, which will meet in Boston, Mass., December 27.

Highway and Surveying Conference. The University of Florida at Gainesville will be host to the 1953 Highway and Surveying Conference, November 19 and 20. The theme of the conference—sponsored by the civil engineering department as a function of the Engineering and Industrial Experiment Station—will be "research."

Mid-Century Conference on Resources for the Future. Resources for the Future Inc., a non-profit corporation for research and education in the field of natural resources, will conduct the Mid-Century Conference on Resources for the Future, in Washington, D.C., December 2–4, with the aid of a grant from the Ford Foundation.

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Men Available

CIVIL ENGINEER, A.M.ASCE; B.S.C.E., 32, married; experience including assistant city engineer, assistant air base installation engineer, project engineer on aircraft hangar and Army depot; master planning air bases, supervision of military construction, inspection, estimating, preparation of plans and specifications; air base maintenance, construction management, budget estimation and preparation. C-894.

CIVIL ENGINEER, A.M.ASCE, M.S. structural; 31; married; thorough knowledge of industrial building structures, plat utilities and material-handling systems; well-rounded in construction problems and labor relations; 8 years' practical experience; responsible charge of a $15,000,000 dollar project. Registered professional engineer. Desires foreign assignment, preferably Europe or a permanent job in the West. C-895.

SALES ENGINEER; A.M.ASCE, 37; married; two children; M.C.E.; registered professional engineer. Early background with state health dept. and consulting sanitary engineer; experienced sales of water and sewage treatment equipment and pumps in public works and industrial fields. Desires responsible broad association with manufacturer or agent. Prefers metropolitan New York but would relocate. C-896.

CIVIL ENGINEER; J.M.ASCE, 24; married; BSCE; currently enrolled evening graduate school. Two and a half years' varied experience as staff member of leading consulting engineer. Desires permanent position in estimating and expediting department of established firm. C-897.

CIVIL ENGINEER; J.M.ASCE, registered professional engineer; BSCE, 28; single; 4 years' experience in Navy Civil Engineer Corps; 4 years with large petroleum company in supervisory and subordinate position. Desires position in management, sales engineering, industrial engineering, or construction work in South or Southwest. Prefers relatively small, established, growing company. C-898.

CIVIL ENGINEER; J.M.ASCE; 27; married; BSCE, Lt. (jg), CEC, USNR; experienced in Navy CB construction and in electrical oil field logging. Desires to learn municipal, sanitary design and construction; hydraulics and traffic control. Location preferred, Rocky Mountain region. C-899-539-A-5-San Francisco.

CIVIL ENGINEER; J.M.ASCE; BSCE, 1 year post graduate; 34; married; registered civil engineer; speaks Spanish. Ten years' experience in structural design, municipal engineering design, estimates, reports and investigations; administration and supervision of planning, design, inspection and production personnel. Desires technical or administrative position in Latin America, Europe or Hawaii. C-900-512-A-11-San Francisco.

CIVIL ENGINEER; J.M.ASCE; MCE; professional engineer; 31; married; teaching experience, 11 years of diversified responsible experience in structural and foundation engineering, including bridges, turnpikes, buildings, railroads, aircraft. Desires teaching position in eastern university for the fall of 1954 in structural engineering and allied subjects. C-901.

PROFESSOR; A.M.ASCE; MSCE; 39; married; 5 years' experience in industry, designing oil field structures and equipment; 6 years in engineering education teaching engineering mechanics, fluid mechanics; surveying and structural engineering. Location preferred, East, Midwest or West. C-902.

SOILS AND FOUNDATION ENGINEER; J.M.ASCE; MSCE from MIT; 5 years' experience in the evaluation and design of airfields; design and preparation of plans and specifications for earthfill dams and foundations; former staff member of leading university. Desires responsible position with opportunity for advancement. C-903.

CIVIL ENGINEER; M.ASCE; professional engineer, Massachusetts and New York; 44; married; well-rounded experience as resident engineer water front construction and foundation work. Broad contract administration experience, military and other government contracts. Desires position affording opportunity for progressively increasing responsibility with architectural engineer. C-904.

CIVIL ENGINEER; J.M.ASCE; 24; married; BSCE 1952, University of Notre Dame; registered engineer in training in Indiana; 18 months' experience in structural steel detailing on bridges and buildings; considerable summer experience in field and office. Desires position with consultant or contractor. Location, East or Midwest. C-905.

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ENGINEER with a knowledge of building construction costs and a broad knowledge of equipment costs in order to establish and current maintain insurable values of various manufacturing plants, lumber yards and other properties. Some traveling. Headquarters, Ohio. Y-8983.

SANITARY ENGINEER to work in public health program. College degree in sanitary or civil engineering. Position covered by merit system. Liberal vacation and sick leave. Salary dependent on training and experience. Location, Delaware. Y-9027.

SUPERINTENDENT with at least 5 years' construction, demolition, wrecking and salvage experience, to survey jobs, prepare estimates, and take general supervision of building demolition and salvage of materials and equipment. Salary, $7,500–$10,000 a year. Location, East coast. Y-9116.

CONSTRUCTION SUPERINTENDENT OR ASSISTANT, with several years' experience on hydroelectric projects. Prefer an engineer with a knowledge of Bureau of Reclamation standards. Must be available in 3 months. Salary open. Location, foreign. F-9127.

PLACER DEVELOPMENT ENGINEER, 35–50, experienced in placer examination and operation of dragline dredges, hydraulics, sluicing, high lift pumping. Experience in reservoir construction and water distribution methods also needed, to function as assistant to chief engineer. Three-year contract. Salary, $8,500 a year (tax exempt) in United States currency. Quarters and living allowance. Location, Ethiopia. F-9129.

COMMISSIONER OF SMOKE REGULATION with at least 5 years' experience in the theory and practice of construction and operation of furnaces and combustion devices or in the theory and practice of smoke abatement and elimination. Should be able to confer with and solicit the cooperation of scientific, educational and civic organizations interested in smoke abatement. Will make a study and survey the city with reference to smoke elimination and work with civil organizations on an educational program. Salary, up to $5,000 a year plus $35 a month automobile expenses. Location, Indiana. Y-9198.

ARCHITECTURAL ENGINEER with degree in architecture or civil engineering and at least 3 years' experience in architectural design. Should be able to render sketches of proposed buildings; preparation of plans and specifications for new construction, additions and changes to existing buildings. Some experience in supervision of construction preferred. Location, Michigan. Y-9203 (*b*).

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CONSTRUCTION SUPERVISOR, young, with excavating and foundation field experience, including operation of excavators, engines, pumps, drills and earth boring equipment. Salary, $4,680–$5,720 a year. Location, Queens, N. Y. Y-9209.

MANAGING EDITOR, under 30, civil engineering degree for civil engineering publication. Will be responsible for conceiving, developing and programming as well as editing. Will carry out a college promotion program with 140 civil engineering colleges, including exhibits, and teaching aids such as manuals, handbooks and information for speeches. Location, Midwest. Y-9218.

TECHNICAL FIELD SUPERVISOR with construction background and engineering training in the building field, to engage in technical sales promotional work on building products salesmen and distributors. Salary open. Location, Cleveland, Ohio. Y-9219.

DRAFTSMEN, civil or architectural, for layout of buildings; drainage, sewers, roads, for Army cantonments. Must be citizens. Salary, $5,700–$7,800 a year. Location. New York, N.Y. Y-9231.

SALES ENGINEER to head up a manufacturing operation for a manufacturer of construction equipment. Should have experience with proportioning of concrete mix and a background of employment with a contractor on concrete construction would be helpful. Must know the construction machinery business from a sales standpoint. Duties will be to establish and promote a complete sales program. Must be willing to travel. Salary open, plus expenses and a percentage of profits. Location, Arizona. Y-9233.

RECENT GRADUATE, civil engineer; 22–25; with 2 years' experience in civil engineering. To check municipal water systems. Considerable traveling. Assignments last about 6 months. Salary, $4,200 a year. Employer might negotiate fee. Location, Chicago. C-1282.

RECENT BOOKS

An Introduction to Scientific Research

E. Bright Wilson, Jr., has prepared a book of practical suggestions for planning and carrying out scientific research, intended for students beginning research and for the experienced research worker with little training in methods of investigation. Principles and procedures applicable to a wide range of sciences rather than to a specific science are presented in the order in which they arise in research. Apparatus design and data analysis are given the fullest treatment. (McGraw-Hill Book Company, Inc., 330 West 42nd St., New York 36, N.Y., 1952. 375 pp., $6.)

The A.I.S.C. Textbook of Structural Shop Drafting, Volume II

Intended as a text for structural draftsmen, this second volume of a two-volume set covers the rather more advanced aspects of structural steel drafting. Two chapters are devoted to welded fabrication of beam-and-column work; the five following chapters are written in terms of riveted or bolted construction. Sample plates are shown. Basic drawing information was included in Volume I. (American Institute of Steel Construction, 101 Park Avenue, New York 17, N.Y., 1953. 160 pp., $3.)

Engineering Mechanics

This elementary textbook by Linton E. Grinter, covers the normal subject matter of statics, dynamics, and kinetics, with a final chapter on virtual work. The author's aim has been to present the material in a logical and unified form which will aid the student in formulating an analytical approach to problems as well as give him the necessary factual information. (Macmillan Company, 60 Fifth Avenue, New York 11, N.Y., 1953. 408 pp., $5.75.)

(*Continued on page 108*)

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(*Continued from page 107*)

Electric Arc Welding

John Benjamin Austin presents a comprehensive treatment of the fundamentals and latest techniques of electric arc welding, the equipment used, and applications in the major fields of welding: hard surfacing, and pipe, machinery, and structural welding. One chapter is devoted to special automatic metal-arc processes, and another describes the common methods of testing welds. The codes used in the various industries are indicated throughout the text. (American Technical Society, 848 East 58th Street, Chicago 37, Ill., 1953. 280 pp., $4.)

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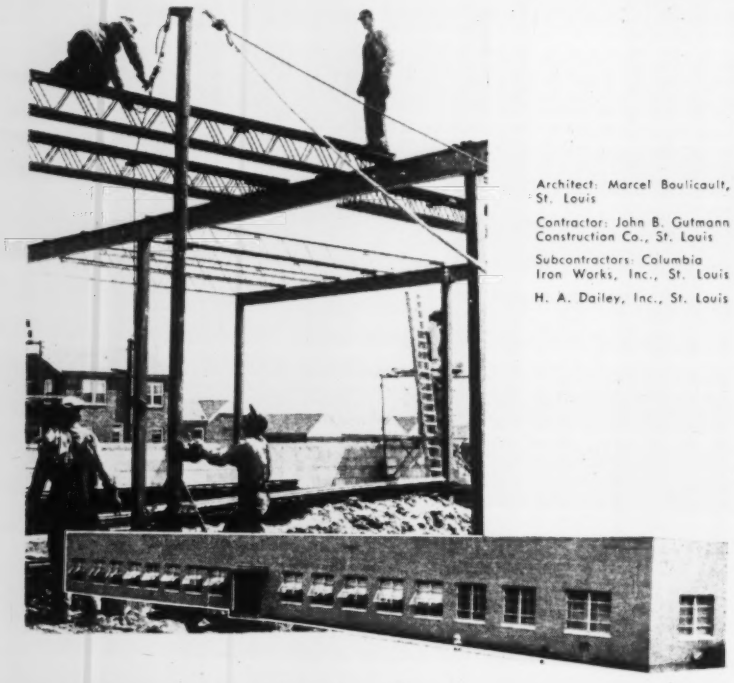
In this study of earth pressures on sheet-pile structures by Rudolf Briske, known methods of calculation are critically presented in the light of available experimental data and observations on structures. A considerable bibliography is included. (Wilhelm Ernst & Sohn, Berlin, 1953. 159 pp., 16.00 DM.)

The Theory and Practice of Reinforced Concrete

Materials and fundamental principles for reinforced concrete structures are covered by Clarence W. Dunham in this first volume of the revised third edition. The present volume is intended for the undergraduate level and provides a working knowledge of design procedures, practical details, and the planning of construction. New material includes recent developments in concrete technology, principles of planning precast concrete, a chapter on forms, and a number of practical design problems. Indeterminate structures and the more advanced material are to be dealt with in a second volume. (McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N.Y., 1953. 499 pp., $7.)



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Probability Tables for the Analysis of Extreme-Value Data

These specialized tables in Applied Mathematic Series 22, find use in the statistical approach to such practical engineering problems as the study of floods and droughts and the fracture testing of metals and other materials. The explanatory introduction discusses such applications as well as the general method of use of the tables, the method of interpolation, etc. (National Bureau of Standards. Available from Superintendent of Documents, U.S.G.P.O., Washington 25, D.C., 1953. 32 pp., $.25.)

Pumps Types, Selection, Installation, Operation and Maintenance

Frank A. Kristal and F. A. Annett have extensively revised and rewritten this edition of a standard text which provides a comprehensive, practical study of the selection, installation, operation and maintenance of available types of pumps covering a wide range of applications-boiler feed, deep well, sewage and sludge, chemicals, oil field products, and others. Major additions occur in the material on diaphragm pumps, rotary pumps, jet pumps, and special pumps for foods. (McGraw-Hill Book Co. Inc., 330 West 42nd St., New York 36, N.Y., 1953. 373 pp., $6.50.)

Reviews of Research on Arid Zone Hydrology

A compilation of official reports on eight major arid zones of the world covering underground water, hydrology and fluid mechanics, and problems of surface and ground water supply. Existing projects are reviewed and suggestions are made for further projects for research and development. The final paper is a study of world distribution of arid and semi-arid homoclimates. Extensive bibliographies are included. (United Nations Educational, Scientific and Cultural Organization, Paris. Available at UNESCO, New York, N.Y., 1953. 212 pp., 25s.)

Symposium on Conditioning and Weathering

A wide range of topics is covered by Special Technical Publication No. 133, to provide a broad picture for technologists in many lines. The fundamentals of atmospheric elements; air conditioning in the manufacture and testing of textiles; conditioning and weathering of paper, adhesives, plastics, and organic and metallic coatings; outdoor exposure testing; and accelerated weathering devices. (American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., 1953. 98 pp., $2.25.)

Prestressed Concrete

A textbook by Y. Guyon, an associate of E. Freyssinet, for designers of prestressed concrete, first published by Edition Eyrolles in Paris in 1951, has been made available in an English translation. The volume is restricted to statically determined straight beams. Part I treats of the basic ideas of prestressing; methods, plant and materials; fire resistance; and anchorage problems. Part II develops the elastic design of simply supported beams with worked examples in English units. Part III summarizes tests on beams, and comments briefly on elastoplastic design. A foreword by E. Freyssinet, one of the first to enunciate and apply the principles of prestress, sets the stage for this book, the first of a series. (John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y., 1953. 543 pages, $13.)

Library Services

Engineering Societies Library books may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 33 West 39th Street, New York 18, N.Y.

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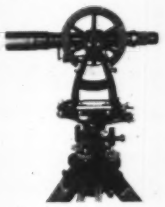

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A Symposium on Prestressed Concrete Statically Indeterminate Structures

The seven papers presented at this symposium deal with various aspects of the problem of continuity in prestressed concrete construction. The topics vary from theoretical analysis to experimental work on interconnected prestressed beams. The practical examples of continuous statically indeterminate structures include a number of actual structures, both bridges and buildings. R. P. Andrew and P. J. Witt are the editors. (Cement and Concrete Association, London, 1953. 180 pp., 25s.)

Positions Announced

U.S. Civil Service Commission. Examinations have been announced by the U.S. Civil Service Commission for Cartographer, Cartographic Aid, Cartographic Technician and Cartographic Draftsman, for filling positions in various federal agencies in Washington, D.C., and vicinity. The salaries range from $2,750 to $10,800 a year. Application forms may be obtained from the Commission's Washington office or from a Civil Service regional office, and must be filed with the U.S. Civil Service Commission, Washington 25, D.C.

City of Berkeley. Applications from professional or practical engineers with leadership, ability and field experience in maintaining street sewers and related public works are invited by the City of Berkeley. The starting salary ranges from $518 to $631 a month, depending upon the applicants qualifications. Examination details are available from Harry Rosenberg, Director of Personnel, City Hall, Berkeley, Calif.

City of Philadelphia. Several openings are now available with the Philadelphia Civil Service including the positions of Traffic Engineer I at an annual salary ranging from $4,930 to $6,192; Traffic Engineer II at $6,480 to $8,140; and Planning Designer I, II and III at salaries ranging from $3,925 to $7,100. Candidates may apply for admittance to the examination, in person or by mail, to the Personnel Department, Room 127, City Hall, Philadelphia 7, Pa.

Maryland State Roads Commission. The position of Junior Assistant Highway Engineer II at a yearly salary of $4,013 to $4,813, is immediately available with the Maryland State Roads Commission. For further information address W. Phelps Thomas, Personnel Manager, Maryland State Roads Commission, Tower Building, Baltimore 2, Md.

Government of Guam. The Government of Guam is interested in obtaining the services of a man qualified to act as its chief of land planning. The position, rated as Engineer IV, carries with it a basic salary of $7,475 per annum. Application blanks and detailed information may be obtained from W. E. Sinclair, Director of Public Works, Government of Guam, Agana, Guam.

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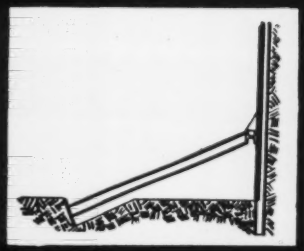

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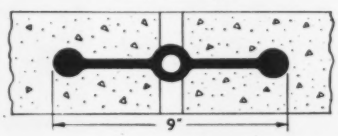

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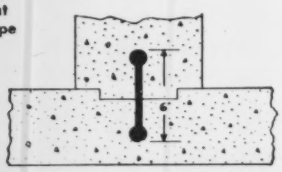

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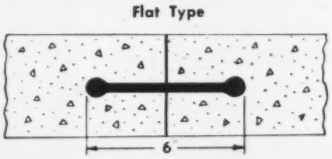

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New in Education

Broadening of the graduate program in community planning through the organization of an inter-department graduate faculty is announced by the University of Florida. The program established in 1948, which leads to the degree of master of science in community planning, was originally open only to holders of a five-year undergraduate degree in architecture. Under the newly expanded curriculum, applicants with more varied backgrounds who have six years of post-secondary study will be eligible for admission. Further information may be obtained from L. E. Grinter, Dean of the Graduate School, University of Florida, Gainesville, Fla.

The Indian Institute of Technology at Kharagpur, near Calcutta, recently opened one of the best equipped departments of civil engineering in southeast Asia. Under UNESCO's Technical Assistance Program, a three-man team headed by Dr. Inge Lyse, A.M.ASCE, Norwegian engineer and authority on concrete, worked for a year and a half planning the college's curriculum and laboratories. Special emphasis has been placed on the field of hydraulics and soil mechanics by the Institute "in order to train men needed for building dams under India's development plan."

Increased interest in engineering shown by high school students in recent months has led to publication of a new booklet, "What's Engineering", by the Stevens Institute of Technology. Designed to answer questions about the work engineers do, the 16-page publication discusses the scholastic attainments and special aptitudes that indicate whether a student should seek admission to an engineering college.

The Clark Equipment Co., Buchanan, Mich., has established a $2,000 scholarship fund at the Illinois Institute of Technology for students majoring in materials handling. Known as the Eugene B. Clark scholarship, in honor of the founder of Clark Equipment, the scholarship will be awarded annually to a junior working for a degree in industrial engineering and majoring in materials handling. The grant will cover tuition costs for the students' final two years in school.

Rennselaer Polytechnic Institute has accepted the largest freshman class in its history for the 1953–1954 academic year. Nearly 30 percent larger than last year's class, the present freshman class has 860 students enrolled in the engineering curriculum. Construction of a $3,000,000 dormitory which will house over 600 students is being rushed to completion. The college received a $2,880,000 loan from the Division of College Housing, Federal Housing and Home Finance Agency, on the grounds that the grant was needed to further defense-related activities—in this case engineering education.

Applications for Admission to ASCE, September 12–October 10

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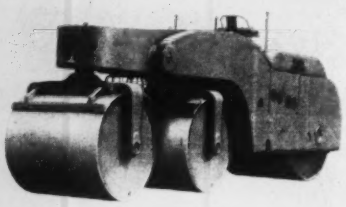
THE DEVELOPMENT of a 13 to 20 ton 3-axle tandem roller, the KX-25D, featuring a revolutionary new concept in compaction, Walking Beam Compaction Control, is announced. The Walking Beam design, when used in the "semi-locked" position, actually applies extra compactive effort to high spots only. This initial leveling action does away with the need for cross rolling, eliminates extra job time and any possible damage to material that has been compacted and set. On the KX-25D, both guide rolls are suspended from a single rotating beam. When beam is "semi-locked," the end guide roll can pivot above but not below its normal position. When the end guide roll encounters a high spot in the material being rolled, the Walking Beam rotates and allows the roll to pass over the hump, exerting only normal pressure. This "prepares" the material for high compaction of the center

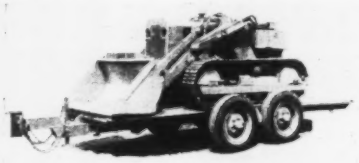


Model KX-25D

guide roll. As the center guide roll rises on the hump, the "semi-locked" Walking Beam causes the entire guide end of the roller to rise with the center roll. This lifts the end guide roll off the surface and transfers its weight to the center guide roll, along with some of the weight of the drive roll. At this instant, the center roll exerts almost three times its normal compaction but only after the material has been "prepared" by the light pass of the first roll. The Walking Beam can be used unlocked for rolling vertical curves and warped surfaces, or it can be used fully locked if conditions warrant. The Walking Beam principle assures an exceptionally smooth road surface, free of objectionable waves and ripples. The pavement is stronger, too, more vibrations-resistant, less likely to deteriorate under constant pounding of road traffic. Besides Walking Beam Compaction Control, the KX-25D incorporates many other outstanding Buffalo-Springfield features including exclusive 4-speed transmission, power package assembled as a single unit, transverse engine mounting, bevel gear final drive, greater operator visibility, more ground clearance, synchronized hydraulic steering, heavy duty brakes. **The Buffalo-Springfield Roller Company, CE 11-112, Springfield, Ohio**

Trailers

TWO TRAILER models have been added to the company's line of cargo, equipment and livestock trailers. The two heavy-duty trailers, Models T-8-14 and T-8-18, are tow-type, between-the-wheel tilt-top trailers and have tandem axles with single wheels in line. Model T-8-14 has a 14 ft platform length and 8-10 ton capacity.



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Model T-8-18 has an 18 ft platform length and 8-10 ton capacity. Both units have a 76-1/2 in. clear inside platform width. For hauling front end loaders, tractors, rollers, mixers, compressors and other heavy equipment, the two models have automatic safety locks for securing platform when loaded or empty. Other standard features include rugged "A" frame type drawbar with safety chains, adjustable support mounted in drawbar for parking trailer, 4 "D" lashing rings, all-welded structural steel frame with oak flooring. Tandem walking assembly incorporates axle camber. **Transport Trailers, Inc., CE 11-112, Cedar Rapids, Iowa**

Labyrinth Waterstop

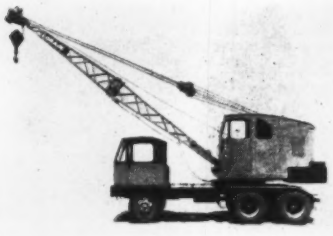
BECAUSE OF DIFFICULT site conditions, the Box Canyon Dam on the Pend Oreille river in Northeastern Washington has become a continuing exercise in resourcefulness for the engineers and crews on the job. Ingenuity has keynoted the project from the planning boards to the present stage of construction, and has kept the work on schedule. An example of this ingenuity is a twin-reel jig developed for applying Labyrinth Waterstop in continuous strips between successive pours of concrete. Labyrinth Waterstop is the new polyvinyl plastic product of Water Seals, Inc., of Chicago and can be easily spliced by the simple process of rubbing a hot knife blade over the joint ends to form a water tight weld. The Box Canyon crew utilizes another advantage of Labyrinth, its flexibility, to use continuous strips of the material. A twin-reel jig was built and attached to the concrete forms. The lengths of Labyrinth Waterstop were rolled onto the reels like ordinary garden hose. Before each pour, the Labyrinth is simply nailed to the face of the form as usual. As the forms are removed, and new forms set for each successive pour, the Labyrinth is unreeled as needed. **Water Seals, Inc., CE 11-112, 9 So. Clinton St., Chicago 6, Ill.**

"Tilt-Up" Slab Brace

DESIGNED FOR fast and efficient positioning and adjusting of precast concrete panels, an adjustable slab brace has exclusive pivoting action and is used with 2 x 4's or 2 x 6's of standard lengths to fit individual jobs. It is also available with fittings for use with pipe instead of lumber. Makeshift, inefficient methods of positioning slabs are eliminated with the new brace. A 4-page Bulletin TU-2 is now available. **Superior Concrete Accessories, Inc., CE 11-112, 4110 Wrightwood Ave., Chicago 39, Ill.**

Moto-Cranes

TWO ADDITIONS to the company's line of Lorain Moto-Cranes have recently been announced. They are Model MC-254W in the "TL" Series, with a lifting capacity



MC-424

of 17-1/2 tons, and Model MC-424 whose lifting capacity is 22-1/2 tons. Model MC-254W is a 3-axle Moto-Crane available as a 3/4 yd shovel, crane, dragline, clamshell, hoe or 1-1/4 cu yd scoop shovel. Overall width is 106 in., giving additional lifting capacity "on rubber," without setting outriggers, while maximum boom length with tip extension is 95 ft. It is equipped with 8 forward speeds, 2 reverse speeds and air brakes. It can travel up to 37 mph. The Moto-Crane may be had with diesel or gasoline power for turntable and carrier, with front driving axle, third drum and other accessories. The 22-1/2 ton Model MC-424 is a two-engine machine with a gasoline-powered turntable or superstructure mounted on a 3 axle carrier, with drive on the two rear axles, powered by a separate gasoline engine at 10 forward speeds (up to 27 mph) and 2 reverse speeds. The carrier has an overall width of 96 in. and is equipped with air brakes. The maximum boom length with tip extension is 125 ft and it may be equipped with diesel power for turntable, third drum, power load lowering, front wheel brakes and many other accessories. The MC-424 is convertible to shovel, crane, clamshell, dragline or hoe booms. **The Thew Shovel Company, CE 11-112, Lorain, Ohio**

Equipment, Materials & Methods (Continued)

Scrapers

A LINE OF open-top, tractor-drawn, rubber-tired scrapers ranging in capacity from 10.5 to 28.5 cu yds is announced. These scrapers are designed to fit any tractor-scraper job and are available in four sizes. The 0-14 Carryall scraper, which is designed for use with tractors of 70 hp or more, has a struck capacity of 8.1 cu yds and a heaped capacity of 10.5 cu yds. 0-19 Carryall scraper for use with 75 or more hp tractors has a struck capacity of 12.2 yds and heaped capacity of 16 yds. The third size of the open-top line, 0-23 for use with 80 or more hp tractors, carries a struck capacity of 14.4 yds and a heaped capacity of 19 yds. The Model 0-35 Carryall scraper carries a load rating of 22.5 yds struck and 28.5 yds heaped and is designed for 100 or more hp tractors. The open-top Carryall scrapers are of welded construction throughout. Their design facilitates shovel or conveyor loading by elimination of overhead cables.

Available in Four Sizes

The scrapers are operated by a double drum power control unit, whose two cables work through swinging sheaves which are self-aligning. They are mounted on the front of the scraper yoke. Other important features of the open-top scrapers include: positive ejection of material; heavy duty roller bearings are used throughout and are protected by oil seals; a hard-surfaced, self-sharpening, reversible blade; replaceable side runners that reduce windrowing by guiding material into bowl; machine-grooved, heat-treated cable sheaves for correct wire rope support; and wheels that are mounted inside the blade's cutting edge. **LeTourneau-Westinghouse Company, CE 11-113, 2301 N. Adams St., Peoria 3, Ill.**

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DELRAC COATING penetrates, seals and waterproofs concrete, mortar, brick, steel and wood. It is a permanent transparent coating which can be used as both primer and finish coat. On concrete, Delrac coating prevents powdering, dusting and fluorescence. It seals the pores of wood and prevents moisture penetration and fungus attack. It is an efficient rust preventive for steel and iron, with excellent adhesion. The coating is a transparent liquid which can be sprayed, brushed or dipped and which is odorless and tasteless when dry. When sprayed on freshly poured concrete, Delrac coating is an excellent curing agent, obviating the need of covering and wetting the concrete during curing. **Delrac Corporation, CE 11-113, Watertown, N. Y.**

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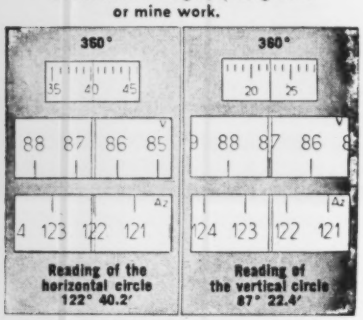

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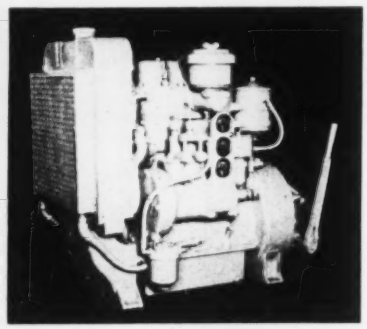
Equipment, Materials & Methods (Continued)

Diesel Engine

THE MODEL 17, a 2-cylinder full diesel engine developing 20 hp at 2000 rpm, has been in the design, development and testing stage for several years. In designing the diesel, Sheppard engineers realized that two important factors which had barred diesel power from many types of equipment had to be overcome. These factors were size and weight. That these



problems are now solved is attested to by the fact that the Model 17 diesel will fit into any space 33 in. long, 22 in. wide and 31 in. high. The compact size and minimum weight of the Model 17 permits installation of this diesel in existing equipment with few design changes. Ideal for use as the auxiliary engine on "mix-in-transit" cement trucks, hay balers, farm machinery and other equipment, the diesel opens the door to diesel economy for countless power users. **R. H. Sheppard Company, CE 11-114, Hanover, Pa.**

Preheat Calculator

THE WELDING PREHEAT and Interpass Temperature Calculator uses slide rule principles to permit quick and accurate calculation of the preheat and interpass temperature required when the hardening or cracking tendency of metal being welded can be minimized by preheating. Experience indicates that in some cases best quality welds in high carbon and some alloy steels are obtained by using preheat. The amount of preheat will vary depending on the chemical analysis of the metal and the thickness. When the analysis and thickness are known, the calculator, working from this information, gives the amount of preheat required for a satisfactory welding procedure. The percentage present of elements such as carbon, manganese, silicon, phosphorus chromium, nickel, molybdenum, vanadium and copper are worked into the calculation along with metal thickness ranging from $\frac{1}{2}$ in. to 10 in. As the number or percentage of elements in steel increases and the thickness of plates to be welded increases, preheating may become desirable for high quality welds. The calculator is designed for the few cases where it is necessary. **The Lincoln Electric Company, CE 11-114, Cleveland 17, Ohio**

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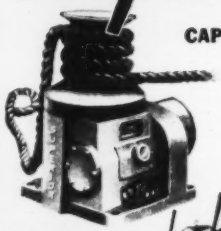
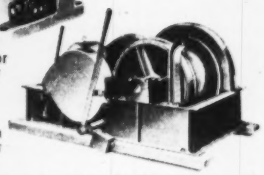


CAPSTAN TYPE, DRUM TYPE AND SPECIAL TYPES



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TIDE GATES

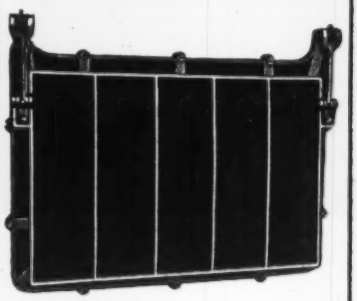

Fig. B-61. Type M-M

Type M-M (Rectangular) Tide Gates are available in 37 sizes from 8" × 8" to 96" × 96". Bulletin No. 71 describes them fully.

BROWN & BROWN, INC.
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Equipment, Materials & Methods (Continued)

Industrial Compressor

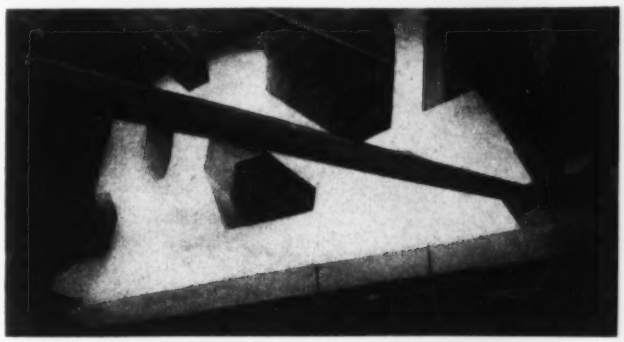
THE SCHRAMM Model 600 Super Unistage is designed to provide 600 cfm of air at 100 psi. Ideal for unit system installation in large industries, the compact 600 cfm compressor is just as suitable as a central supply of air where 600 cfm is sufficient to supply the entire air needs. Powered by a 150 hp induction motor (synchronous motors available) the Super Unistage has 43 percent greater capacity than the formerly largest industrial unit manufactured by the company, but requires little more actual floor space for installation. The unit is vibrationless, can be installed without an expensive foundation and can be moved from one location to another in a factory on a fork truck. It is available with running water cooling or with cooling unit built in with or without a hood. **Schramm, Inc., CE 11-115, West Chester, Pa.**

Loader

IMPROVEMENTS on all three models of the company's hydraulic power-crowd loader is announced. The exclusive hydraulic power-crowding feature of the

Improved Models

Lessmann loader now exerts a forward thrust of 15,000 lbs while the unit is standing still. This permits the shovel loading of even frozen sand and aggregate and digging in unusually hard or compacted soils. The loader will dig 12 in. below wheel level. A variety of bucket capacity from $\frac{1}{2}$ to $1\frac{1}{4}$ yds are interchangeable on the unit by means of four steel pins. Crane hook, lift forks and a dozer blade are also available. The unit will load in the front end of the highest truck when the truck is approached from the rear. Bendix Hydro-Vac brakes, Vickers power steering and an all-weather cab are optional equipment on this highly maneuverable unit. Components of this unit-built loader are standardized parts such as Vickers, Bendix, Ford, Timken, etc. This assures highest quality construction and availability of parts for quick, low-cost servicing. **Lessmann Manufacturing Company, CE 11-115, Des Moines, Iowa.**



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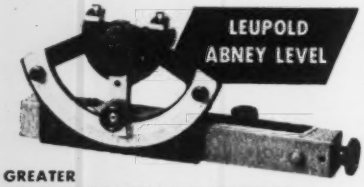

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Equipment, Materials & Methods (Continued)

Flexible Driving Shaft

AN EFFICIENT, low cost, power take-off drive is being used by many fleet operators. This unit easily handles trailers loaded to as much as 20 tons. The drive is used to run a pump for a hydraulic hoist. The unit consists of a 1¼ in. flexible shaft in combination with a square telescopic bar and tube. The flexible shaft provides a powerful, quite flexible

drive which requires very little maintenance. It is very simple to install and eliminates expensive and delicate power couplers. The telescopic rod not only acts as a simple fool-proof quick-disconnect coupling, but it also takes care of the change in length when the tractor-trailer is jacknifed. A universal joint of 18 hundred inch pound capacity, is used between the pump and the telescopic rod so that the flexible shaft does not have to be bent so severely. By using different length extension bars at the power take-off end, the fleet operator may use the same length flexible shaft for his entire fleet so that a few shafts may be stocked for quick replacement. If powered 5th wheels are already in use, short flexible shafts may be used to connect from the power take-off shaft to the universal joint at the powered 5th wheel. This eliminates several universal joints and the sprocket drive. **Stow Manufacturing Co., CE 11-116, 443 State St., Binghamton, N. Y.**

Portadrill

THE MODEL BHD "Air Blast" Portadrill is a compact, highly mobile unit especially designed for the fast drilling of vertical holes in a variety of mining applications, rock and overburden excavation and exploration of underground formations. It combines extremely high penetration speeds with safety and economy under all operating conditions. Mounted on a standard truck chassis of suitable capacity, the Portadrill is highly maneuverable on or off roads and highways, in mine pits, quarries and practically any construction location. The exclusive features and basic designs that have proved so advantageous in other drilling fields are included in the BHD Portadrill. Its application in the mining and construction industries solves critical blast hole and exploration drilling problems; reduces removal costs in stripping operations, open pit mining and all other types of rock excavation projects. **The Winter-Weiss Co., CE 11-116, 2201 Blake St., Denver, Colo.**

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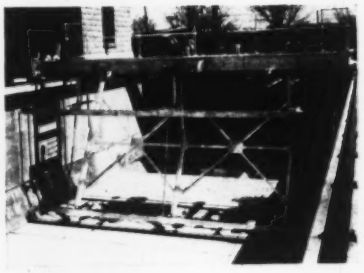

Particularly suitable where space is limited or where sludge delivery is desired at one end of tank. Consists of a bridge crane spanning width of the tank supporting sludge scraper and skimmer, which moves automatically back and forth.

Many of these units are now operating in sewage plants throughout the country.

This unit has also proven highly successful as an oil-water separator in the treatment of oil refinery waste water. Bulletin 31-D-37.

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Equipment, Materials & Methods (Continued)

Culvert Pipe

NESTABLE TYPE culvert pipe, produced of corrugated galvanized sheets 25½ in. wide, curved to form half circle sections, is solving problems for engineers by simplifying methods of packing, shipping and application. The culvert pipe is made in short sections for ease in handling. Several sections are "nested" together with necessary nuts and bolts attached in a separate carton. This method of handling requires only a fraction of the space needed for standard circular culvert pipe. The only tool necessary in laying the pipe is a structural wrench. The longitudinal edges of each section are formed with flanges in which slotted holes are provided for bolting sections together. Sheets are corrugated ½ in. deep with 2.66 in. spread from center to center of corrugations. Sections are 25½ in. in length and every two sections, when assembled make a 24 in. length of full circle pipe from center to center of lapped corrugations. Nestable type culvert pipe can be furnished in either copper steel or pure iron with a galvanized coating of two ounces per sq ft. The flanges are painted, after forming, with black acid-proof paint, with this coating extending up approximately 1½ in. on the curved portion of the pipe section. Field assembly is easily accomplished as sections are interchangeable and are made so that they can be used as either top or bottom half of the full circle. The usual practice is to lay the sections, starting at the downstream end and lapping each section one corrugation over the previously placed section. When placing the top halves start at the upstream end and place the first 2-ft section by extending it two or more corrugations so that the circumferential laps will not be directly opposite the ones on the bottom half sections. **Wheeling Corrugating Co., CE 11-117, Wheeling, W. Virginia**

Diamond Blades

DIAMOND BLADES are now available in a specification especially suited for the cutting of softer groggy materials, such as concrete block, Haydite, Waylite, pumice block, soft tiles, certain refractory materials, etc. Until recently diamond blades were recommended only for the cutting of hard, vitreous materials, but through the development of new metal alloy bonds that "hold on" to the diamond particles (preventing the groggy materials from "tearing away" the diamond particles from the cutting edge), an entirely new range of softer masonry materials can now be economically cut with diamond blades. The use of diamond blades for masonry and concrete saws has become generally accepted as the fastest, most economical way of cutting glazed tile, face brick, natural stone, glass block, marble, porcelain, acid-resistant brick, and many other building materials, clay and concrete products. **Clipper Manufacturing Co., CE 11-117, Suite 813, 2800 Warwick, Kansas City 8, Mo.**

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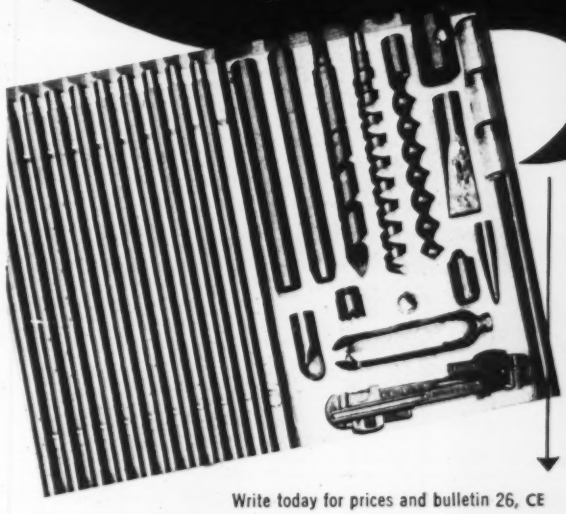

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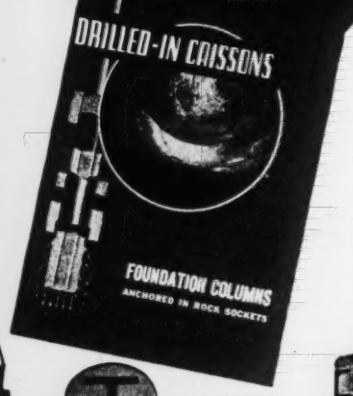

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Equipment, Materials & Methods (Continued)

Rock Drill

THE EECO ROCK DRILL is a complete unit: compressor, drill and feed, air lines, motive power. Complete in itself, it travels and drills with its own power. Tractor mounting provides speed and maneuverability, eliminating tow-tractor and brute-force. Any tractor with sufficient power to drive the compressor may be used, such as

Flotation Drilling

Caterpillar D8 or RD8, Allis-Chalmers, HD14, 19, or 20, etc. The 20 ft 6 in. feed assures continuous drilling for 20 ft with one steel. Longer holes are drilled faster with 20 ft sections. The flexible boom is designed to drill any selected direction or angle without delay. It is easy to position, up—down—around. The drill is operated from a movable control panel allowing operator to stay away from the face. Dust can be eliminated to comply with regulations. Flotation drilling is a new and exclusive method developed by EECO, preventing stuck steel and lost holes. It eliminates drilling delays from blowing. **Eugene Engineering Company, CE 11-118, 1485 W. First St., Eugene, Ore.**

Fire Retardant Paint

ENGINEERS AND CONTRACTORS are watching with a great deal of interest the recent development of an Underwriters Classified fire retardant paint. The material adds an entirely new approach to fire prevention and safety on steel, wood, masonry as well as highly combustible surfaces such as cellulose board. Because every drop of this paint is claimed to contain a mass of minute "built in" fire extinguishers; when exposed to flame Fyr-Kote pours out carbon dioxide and calcium chloride which smothers fire and retards the spread of flame right on the surface. Fyr-Kote is an extremely washable flat wall paint, withstanding more than 25 cycles of scrubbing with strong washing powder and boiling water. Easy to apply, economical, solid covering and long lasting. **Fyr-Kote, Div. of Morris Paint & Varnish Co., CE 11-118, 27th & Douglas, Omaha, Neb.**

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WATER, SEWAGE EQUIPMENT—Equipment for sewage treatment, water purification and industrial waste treatment is described in a 16-page Book No. 2440. Case histories of typical installations, large and small, with photographs and schematic drawings, are presented. Many types of Link-Belt sanitary engineering equipment are pictured, including straightline and circuline collectors, Thru-Clean and straightline bar screens, Tritor screens, straightline and flash mixers, scum breakers, grit collectors and washers. **Link-Belt Company, CE 11-119, 307 N. Michigan Ave., Chicago 1, Ill.**

CONCRETE PRODUCTS—The complete line of standard and custom-made concrete products available, is described in a folder. Among the products illustrated are plain and reinforced concrete sewer pipe, culverts, site cast pipe, large diameter pipe, long length pipe, special pipe for carrying corrosive industrial wastes, flat base pipe, rubber gaskets, river weights, precast package bridges and concrete cribbing. **Universal Concrete Pipe Co., CE 11-119, 297 S. High St., Columbus, Ohio**

DRILLING EQUIPMENT—Bulletin 86 has valuable information on diamond core drills, equipment, supplies and also the company's contract drilling service. Photographs, specifications, detailed data make this of special interest. **E. J. Longyear Company, CE 11-119, Foshay Tower, Minneapolis, Minn.**

CRANE—Catalog No. 85 on the Orton one-man Aero-Crane, designed for mobile yard work, is available. Construction details are listed, operating ease and mobility, torque control, described. Diagrams, photographs, charts are included. **Orton Crane & Shovel Co., CE 11-119, 608 S. Dearborn St., Chicago 5, Ill.**

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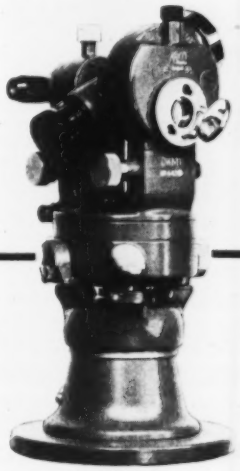

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JOINT SEALING PROCESS—A 30-page catalog describing materials and application methods in its three-step cold applied sewer joint sealing process has just been published. The catalog includes complete specifications and laboratory data on the sealing compounds, illustrations of projects on which the Presstite process has been used, and complete directions for applying. **Presstite Engineering Company, CE-11-120, 3786 Chouteau Ave., St. Louis 10, Mo.**

DRAFTING MACHINES—Unusually realistic illustrations feature a new drafting machine booklet just printed. The two-color booklet presents a complete mechanical description of the various drafting machine models including gravity compensated, track type, civil engineering, and detail machines. **Charles Bruning Company, CE 11-120, 4700 Montrose Avenue, Chicago, Ill.**

STEEL FORMS—Steel forms for building concrete curbs, curb and gutters and sidewalks are discussed in a booklet. Interchangeable face, build-up, heavy duty, dowel, two-piece, rigid radius, flexible radius, specials such as island forms are thoroughly discussed and pictured. Ask for Bulletin L-20. **Heltzel Steel Form and Iron Company, CE 11-120, Warren, Ohio**

BLASTING BULLETIN—First issue of a new quarterly technical bulletin, designed to assist mine and quarry operators, construction engineers, pipeline companies, lumbering firms and other users of industrial explosives, has been published. The four-page illustrated bulletin, titled "Better Blasting," describes modern blasting techniques in practical, readable fashion. **Technical Division, Atlas Powder Company, CE 11-120, Wilmington 99, Del.**

INDUSTRIAL INFERENTIAL METER—A colorful and information-packed bulletin, describing the Type MO Meter, has been prepared. The 16-page bulletin, No. 500, contains data on operation, construction, accuracy, primary devices and other general information of interest to power, process and sanitation engineers who deal with fluid flow problems. The Type MO instrument is perhaps the most accurate Venturi type meter now available. It provides a means of obtaining very accurate measurement of fluid flows over remarkably wide ranges and is designed for water, sewage, sludge and industrial liquors. **Simplex Valve and Meter Company, CE 11-120, 68th and Upland Sts., Philadelphia 42, Pa.**

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therefore give a good idea of the on-the-job performance of a Galion grader. Also included are animation sequences of the operation of the Galion hydraulic system, hydraulic side shift, gear type tandem drive, and range of operating speeds. All types of operations, such as flat bottom ditching, bank sloping, grading, mix-in-place, etc., are presented in detail. In addition, many interesting factory scenes are included showing important steps in the manufacture of Galion graders. Those who would like to show the film, such as engineering schools, clubs, and other organizations interested in better roads, are requested to write direct to **The Galion Iron Works & Mfg. Company, CE 11-121 Galion, Ohio**

HEAVY EQUIPMENT—A 16-mm sound-color motion picture, "Digging For Your Future," is available for distribution. It tells a twofold story: How Bucyrus-Erie products help to shape the earth for better living and how these products are conceived, designed, built, tested, applied in the field and continually improved. The film opens with a series of views showing familiar examples of modern progress—all of them directly dependent on the work of excavating, earthmoving, or drilling machines—and moves on to typical views of such equipment at work: general purpose shovels, draglines, and cranes; quarry and mine shovels; a walking dragline; a 36 cu yd stripping shovel; a 250 ton railway crane; water and oil well drills; a bulldozer and a 22 cu yd scraper. The questions "How have they come to be?" "How are they built?" initiate the second principal section of the film. The answers to these questions are provided through intimate views of the various states of the manufacturing process, from research in the field to testing of a finished excavator. The final section of the film shows field views of additional representative models in the Bucyrus-Erie lines of products, grouped according to the plant by which they are produced, and closes with further examples of how each of these machines, in its own way, is "Digging for Your Future." **Bucyrus-Erie Company, CE 11-121, Publicity Dept., South Milwaukee, Wis.**

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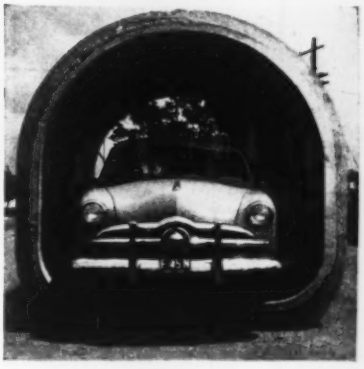

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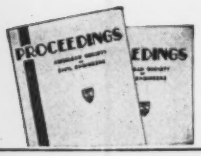

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July

200. **Sand Compaction by Vibroflotation,** by Elio d'Appolonia, Callix E. Miller, Jr., and Thomas M. Ware. (SM)

201. **Wind Loads on Truss Bridges,** by John M. Biggs. (ST)

202. **The Application of Heaviside's Step-Function to Beam Problems,** by John E. Goldberg. (EM)

203. **Control of Aquatic Growths in Reservoirs by Copper Sulfate and Secondary Effects of Such Treatment,** by Ray L. Derby and D. W. Graham. (SA)

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205. **Bending of a Constrained Circular Beam Resting on an Elastic Foundation,** by Enrico Volterra and Randall Chung. (EM)

206. **The Effects on Structures of Winds of Hurricane Force,** by Herbert S. Saffir. (ST)

207. **Current Research in Sanitary Engineering at the University of Florida,** by David B. Smith. (SA)

208. **The Key West Aqueduct,** by P. Corradi and Burr Lenhart. (SA)

209. **The Gilmore Street Bridge, Jacksonville, Florida,** by Paul M. Huddleston. (ST)

210. **Mapping the Unknown Everglades,** by Jon S. Beazley. (SU)

211. **Photoelastic Analogy for Non-Homogenous Foundations,** by Allen J. Curtis and F. E. Richart, Jr. (EM)

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220. **Studies of Settlement and Seepage at Clark Hill Dam During and After Construction,** by Frank M. Bell. (SM)

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248. **Advances in Sewage Treatment in the Period from October 1, 1951, to September 1, 1952:** Progress Report of the Committee of the Sanitary Engineering Division on Sewerage and Sewage Treatment. (SA)

249. **A Method for Calculating Stresses in Rigid Frame Corners,** by Harvey C. Olander. (ST)

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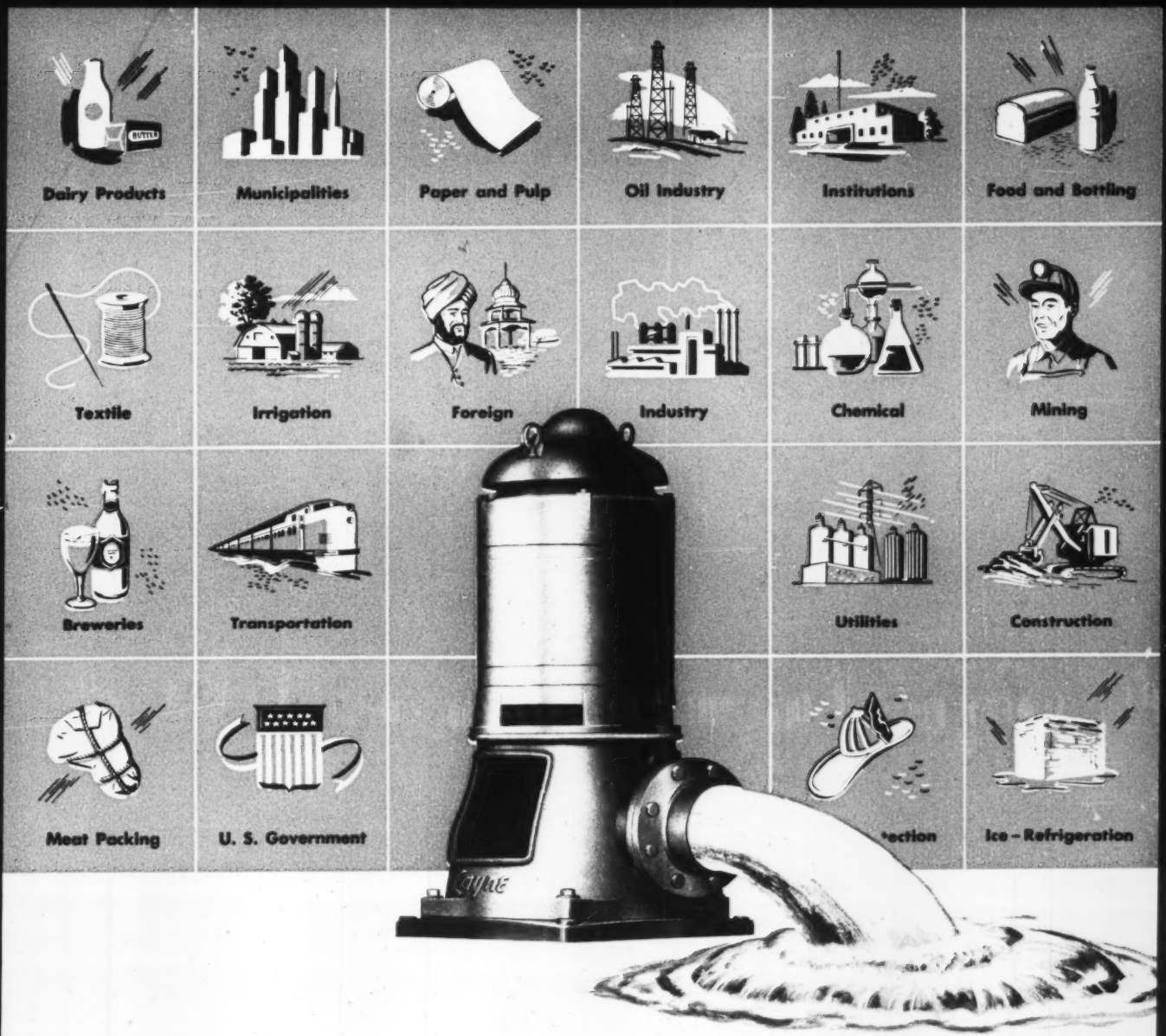

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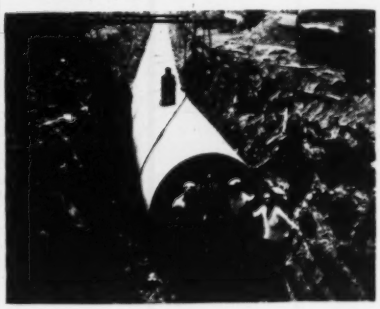
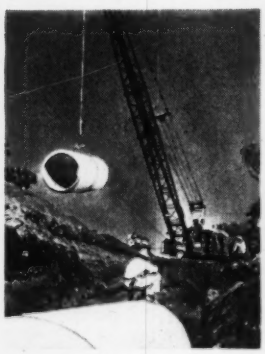
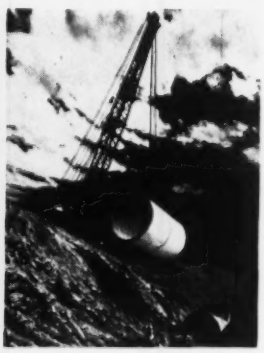


YEAR AFTER YEAR satisfied customers turn and return to Lock Joint to solve their pressure pipe problems. The customers listed on this page have reordered Lock Joint Pipe from twice to more than forty times for the continuing construction of major water works installations . . . a total of nearly 1,500 miles of Lock Joint Pipe delivered on *reorders alone*. The variety of Lock Joint's designs makes the pipe suitable for any water works project requiring pressure pipe 16" in diameter or larger. Its low first cost, negligible maintenance charges, permanent high carrying capacity and unfailing service cause more and more water works officials to agree that "You can't go wrong with Lock Joint."

Laying 66" Lock Joint Reinforced Concrete Pressure Pipe for Tulsa, Okla.





Installation of 90" Lock Joint Reinforced Concrete Pressure Pipe for Denver, Colo.

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SCOPE OF SERVICES—*Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains 16" in diameter or larger, as well as Concrete Pipes of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous Lines.*

LOCK JOINT PIPE COMPANY

Established 1905

P. O. Box 269, East Orange, N. J.

PRESSURE PIPE PLANTS: Wharton, N. J., Turner, Kan., Detroit, Mich., Columbia, S. C.

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LOCK JOINT
Reinforced Concrete
PRESSURE PIPE